BRAYLEY'S
ARRANGEMENT
OF
FINGER PRINTS
IDENTIFICATION
AND THEIR USES
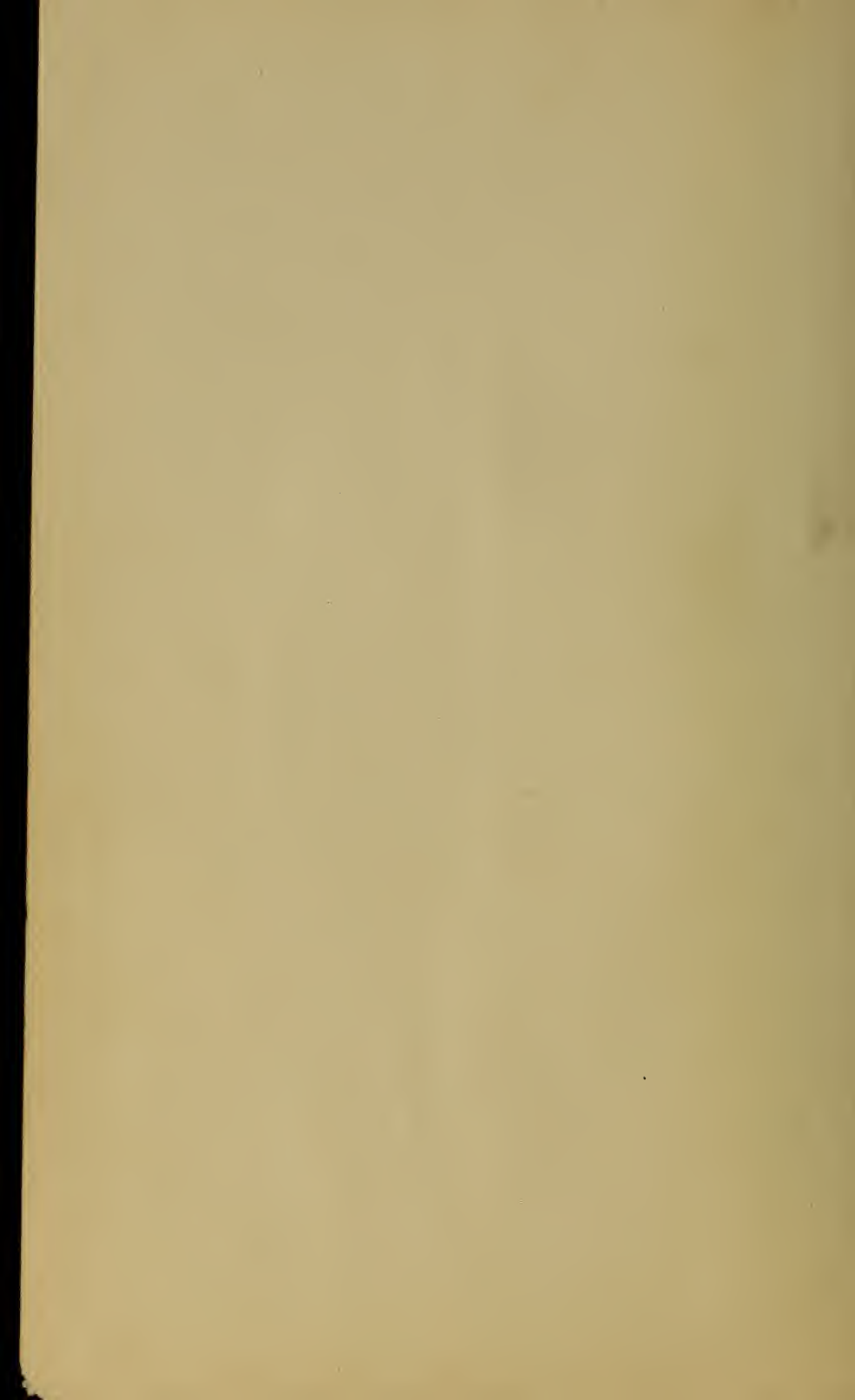
HENRY RICHARDSON
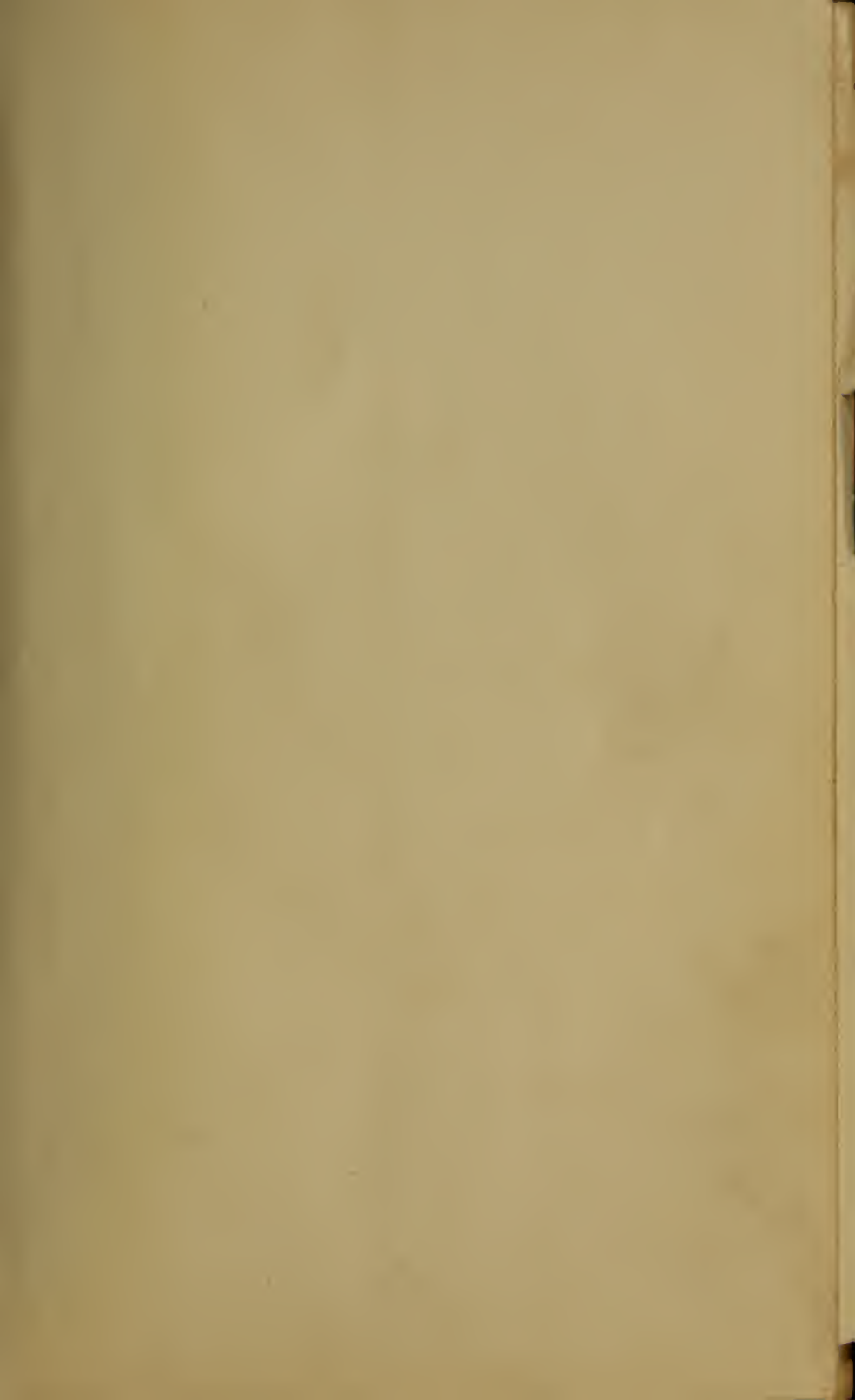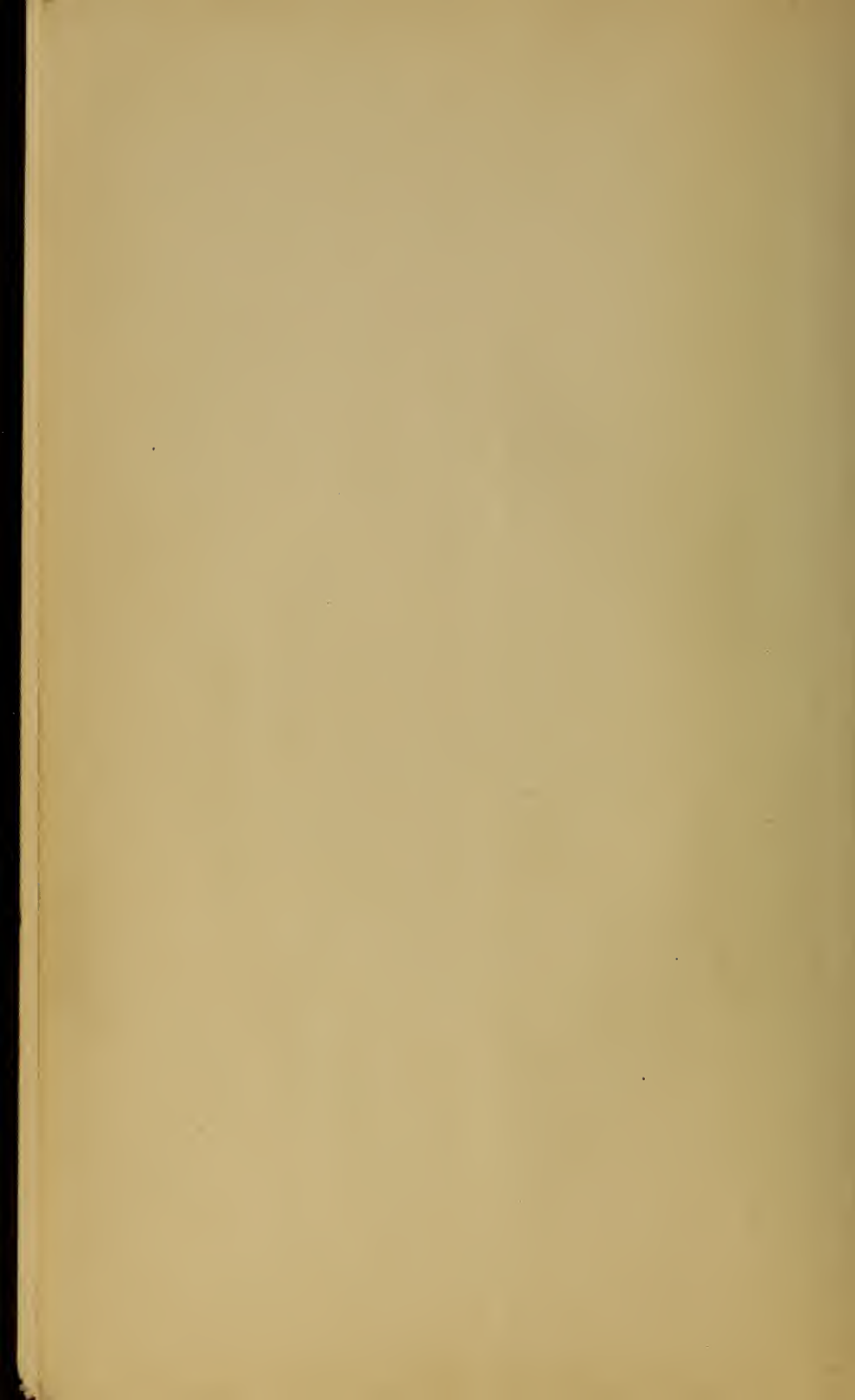MASSACHUSETTS AGENT FOR IDENTIFICATION OF CRIMINALS

BRAYLEY'S ARRANGEMENT

OF

FINGER PRINTS

IDENTIFICATION

AND THEIR USES

FOR

Police Departments, Prisons,
Lawyers, Banks, Homes,
Trust Companies,
Steamship Companies,
Secret Societies
Political Uses,

and in every branch of business where
an infallible system of identification is
necessary.

THE WORCESTER PRESS
PUBLISHERS
BOSTON

FAVOR PHOTOS AND FINGER PRINTS.

When the convention of the International Association of Chiefs of Police, which was held in Buffalo, N. Y., June 18, 1909, resumed business, the Committee on Resolutions reported, among others, the following resolutions:

"That it is indispensable and should have the support of all good Citizens that any person who has been arrested by an officer of the law for a criminal offense, or any person under indictment by a grand jury; or any person who is under strong suspicion of crime sufficient to place him in the class of 'Suspicious Persons' may be photographed, measured and finger-printed by Officers of the Law, due regard being taken to consider the seriousness of the suspected crime, and also to the humane, careful and proper treatment of the person."

"If acquitted said photographs and measurements should be returned or destroyed."

COMMONWEALTH OF MASS.

Chap. 360 Acts of 1910
  Approved April 8, 1910
    In effect May 8, 1910

Relative to the Identification of Prisoners.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

The prison commissioners shall require the officers in charge of state and county prisons to make descriptions of all prisoners committed to their custody for larceny or any felony, in accordance with the finger print system of identification. The descriptions and finger prints so made shall be sent to said commissioners for filing and comparison. All finger print impressions made by the police of any city or town, or duplicates thereof, shall be sent to the prison commissioners to be recorded and kept as provided in chapter four hundred and fifty-nine of the acts of nineteen hundred and five.

PREFACE.

The success of the Finger-Print System of identification in assisting the Police Departments in India, Great Britain and most all of the British colonial possessions and dependencies, and its adoption by New York, Massachusetts and other States in America, suggest the issuance of this publication not only for Police Department service, but to point out some of the many uses to which such a reliable and simple system can be applied in the commercial world, as well as in political and family circles.

These phases of the uses of the Finger-Print System have never been placed before the public until this publication, and in addition to this we offer a system of classification and filing superior to any other system now in use, either in the United States or foreign countries, and have simplified the work of recording to a minimum, so that anybody, after explanation, can readily file all the records likely to come under the business of insurance offices, banks, trust, bond and express companies, secret societies, shipping offices, etc.

We have endeavored to place the whole system before our readers in as simple wording as possible, so as to make it plain, and by its assistance enable any one to take charge of the whole operation from taking the impressions, classifying, filing the records, etc. We are indebted to E. R. Henry, C. V. O., C. S. I., for a large part of our explanation of the Indian and British systems, and to Mr. Richardson, agent for the Massachusetts Criminal Bureau of Identification, Boston,

Mass., for the information as to the system of classifica-
tion and filing records used in the Department under
his charge, which is up-to-date, and from its simplicity,
and at the same time reliability and adaptability for
ready and speedy search and comparison of finger
prints, cannot be improved upon.

This work will be found instructive, as well as inter-
esting, not only to those engaged in the prevention of
crime and the curtailment of possibilities of escape from
detection, but to bankers, insurance companies, trust
companies, secret societies and all others who have to
place signatures beyond a question of doubt, as to
authenticity, or requiring infallible proofs of identity,
this system is invaluable and should be in the hands of
all interested in requiring such evidence.
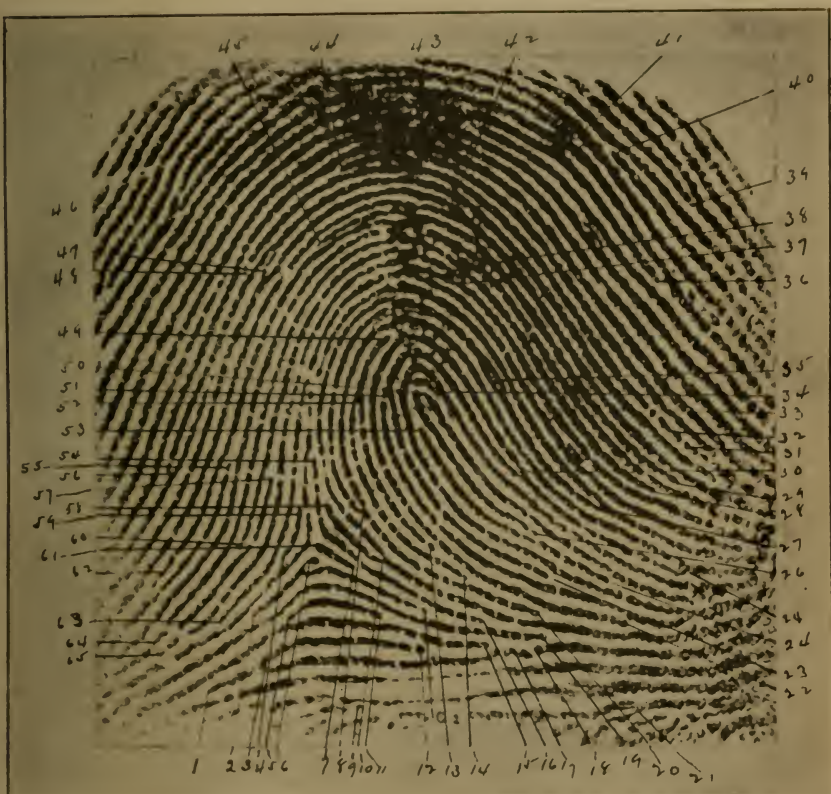
In the above illustration there are noted sixty-five ridge characteristics. The impossibility of finding a duplicate of this finger print with all these characteristics must be apparent to the most casual observer.
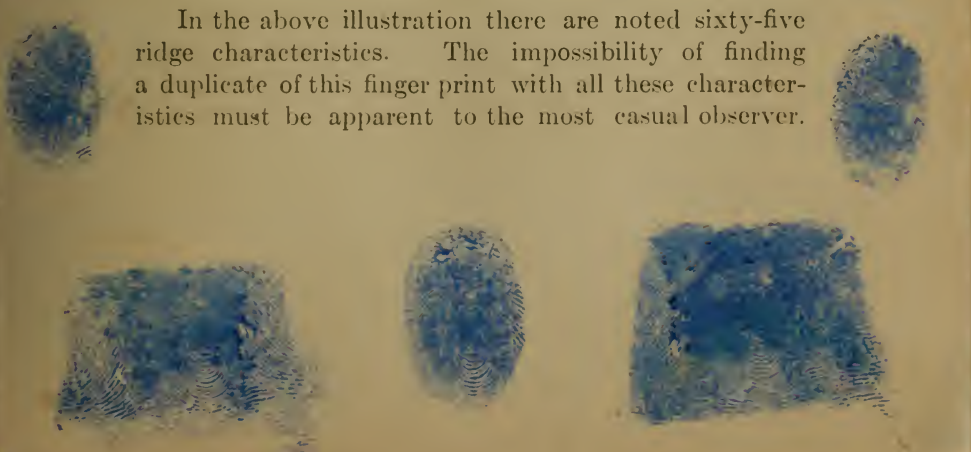
FILING CABINET FOR FINGER PRINTS

KEMPSVILLE LODGE, A. F. & A. M.
KEMPSVILLE, PA.

SIGNATURE

( ) FINGER PRINTS

L. FORE FINGER

ADDRESS

NAME

19

SECRET SOCIETY CARD

The black lines in the above finger print point to ridge characteristics

BANK CARD

The black lines in the above finger print point to ridge characteristics

THE BIRTH OF FINGER-PRINTS IDENTIFICATION.

"God's finger-print language," the voiceless speech, and the indelible writing imprinted on the fingers, hand palms, and foot soles of humanity by the Allwise Creator for some good and useful purpose in the structure, regulation, and well being of the human body, has been utilized for ages before the civilization of Europe as a means of identification by the Chinese, and who shall say is not part of the plan of the Creator for the ulti- mate elimination of crime by means of surrounding the evilly-disposed by safe-guards of prevention; and for the unquestionable evidence of identity in all cases where such is necessary, whether it be in wills, deeds, insurance, or commercial mediums of finance, as well as in the discovering and identification of lawbreakers.

The importance of the employment of finger-prints in many branches of public business, as a check upon false personation, caused the Government of India to have prepared a book of reference which was divided into two parts, containing over 200 diagrams, to illus- trate the letter press.

Part one was compiled for use of departments, such as Registration, Pensions, Post Office, Survey, Opium and others, who take the impression of a single digit.

Part two is a system of classification, the full text of which is arranged for the Police Department.

The student of the finger-print language will find it a most interesting study, and many eminent men have for years given much labor to its investigation.

The employment of finger-prints amongst various nations in the past is dwelt upon by Mr. Francis Galton, who has made a specialty of this new branch of inquiry and who finds the significance attached to their use partly superstitious, and partly ceremonial; for instance, the modern witness when sworn on the Bible is made to hold it and kiss it, and an executant of a document puts his finger on the wafer and declares "this to be my act and deed."

The finding of false impersonation prevalent in the courts in Bengal, India, caused Sir William Herschel, when in charge of the Hooghly District, to introduce the use of finger impressions as a means of identity, and accordingly he insisted upon executants of documents for registration affixing their finger impressions on the register, and advocated the adoption of this system throughout the Province. The results of his labors were not so fruitful as deserved, but were of great use to Mr. Galton in his work.

For ten years the finger-print system has been in use in the postoffices of India, in the medical department of the government, and the local medical board. In the examination of candidates in public examinations in India, it is believed that at times the candidate who presented himself at the examination hall was not the person who secured the certificate, which entitled him to compete in examinations for employment in the government service.

The effectiveness of finger impressions in proof or disproof of identity so fully convinced the Indian Government that a special act was passed in 1899 (India Council) declaring relevant the testimony of those who had studied finger-print decipherment, and which was not considered admissible before under the old law.

It was introduced into England in 1901 and the number of identifications being so satisfactory and so supe-

rior to those effected by any other method, that in 1905 the Secretary of State for the Home Department ordered its adoption, and it is maintained by the Metropolitan Police in New Scotland Yard, and records of the impressions of all convicted criminals are forwarded by the governors of prisons to The Habitual Criminal Registry, New Scotland Yard. It is now being used by the Police Departments in most of the leading cities of the United States as well as the Federal Government in the army and navy of the United States..

The success of this system and its effective use in India, have led the English Government to introduce it in Ireland, Australasia and Africa, and it is only a question of time when it will be in use in all the civilized countries of the world. A universal system of classification and interchange of impressions between the various bureaus of criminal identification will reduce to a minimum the escape of criminals and the operations of anarchists and "Black-Hand" fugitives.

The testimony of an official of great experience and a well-known authority on this subject, supports the opinion of the author as expressed in the foregoing paragraph.

After giving the readers the results from the experience of officials of the British Government in India and in the Metropolitan Police Department of London, we have much pleasure in presenting the testimony of one of our country, namely, Mr. Henry Richardson, the agent of the Massachusetts Bureau of Criminal Identification, who has made a careful and exhaustive study of the finger-print system, and by practical demonstration of the system, and the instalment of a concise system of classification and filing, places himself prominently in the lead as an authority, and is recognized as such by the police departments of many cities. This gentleman says:

THE FUTURE USE OF FINGER PRINTS

"It will soon supplant the Bertillon system as a means of criminal identification because of its simplicity and the accuracy of its results."

"The time is near when insurance companies will require finger-prints of the person insured in order to guard against fraud by false impersonation.

"Banks and express companies will also have finger-prints of their employees in order to have a certain means of identification in case of defalcation.

"Persons when making wills will impress their finger-print to prove signature as genuine which will be convincing evidence of the will of the testator.

"Every family will eventually have their finger-prints filed away for identification purposes in case of fatal accident or kidnapping.

Shipping companies and ship owners should have one or more impressions taken of all officers, and crews, and in relation to passenger ships, the passengers could be identified in cases of shipwreck or collision.

Public schools could also be included in such a system, the impressions taken from each pupil's digits on entering even the kindergarten grade, and copies sent to a central Federal Department in Washington, D. C., for classification and filing. The finger-prints of any taken in childhood would be available in after years for comparison (no matter how old the case under inquiry would be) and even after death, until decomposition obliterates the prints, the subject of inquiry may be traced to the starting point in life.

If registered voters were obliged by law to have a thumb or finger print impression taken the identity of the voter, if his vote was challenged, could be easily determined with absolute accuracy.

A SMALL EQUIPMENT.

The practicability of identifying criminals by the finger-print method alone is being demonstrated daily at the State Bureau. Every day the telltale finger-print system is uncovering men who are sailing under false names and under changed appearance.

An instance of how valuable the finger-print is for identification purposes was lately given by an arrest in New Bedford, Mass. The man arrested protested that he had never been arrested before. He also gave an assumed name. His finger-prints were taken and sent to the State Bureau, where it was quickly discovered that they were the finger-prints of a man who had been arrested in Springfield, Mass., as a fugitive from justice being charged with stealing a horse eighteen months previously in the city of Lynn, Mass., The prisoner confessed his identity on the evidence of the finger-prints.

"All that is required in taking finger-prints," says Agent Richardson, "is a printer's roller, a piece of glass and some printer's ink, and blanks for the finger-print impressions. That is the whole equipment. Any police department can have such an equipment and any policeman can take a finger-print. But every policeman cannot take a Bertillon measurement and most of the towns do not take any measurement of their prisoners. Again, men of various degrees of experience in taking Bertillon measurements may vary slightly in their measurements, and thus defeat its purpose.

Banks, insurance companies and any class of business where it is unnecessary to take impressions of all the digits, but who may require the impression of one digit only, can provide themselves with a small ink pad

for taking a finger-print, and thus obviate the necessity of the complete outfit above mentioned, which is used in prisons and police departments.

A small card index cabinet* is all that is necessary for use in banks and other lines of business, thus eliminating the large, and to some extent intricate, system used by Central offices and large police departments.

THE SYSTEM EMPLOYED.

"If I had a million or two million finger-prints I could find the finger-print of any man in a few minutes if they were among my collection, so minute is the system of classification and sub-classification that is employed." There is, according to Professor Galton, the eminent mathematician, only one chance in 64,000,000,-000 that two finger-prints will be alike, so you can see the absolute impossibility of the 10 fingers of one person resembling the 10 of somebody else.

Classification of finger-prints with absolute accuracy is a simple task. There are 1,024 primary classifications and innumerable sub-classifications. Finger-prints can be quickly classified and filed away, and it is very easy to find one from a duplicate.

"The day is coming when the people of the country will wake up to the value of the finger-print. At present, taking finger-prints and identifying a criminal by them is a mysterious proceeding to the public. When they become aware of the simplicity and the absolute certainty of the whole procedure, it will be a short time only before the finger-prints will be in use for all kinds of identifications and for the prevention of crime as well.

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* The Publishers will cheerfully furnish information regarding a proper selection of filing cabinets and supplies to meet all requirements.

ITS VALUE IN WAR TIME.

"The United States has adopted the finger-print system of identification in the army and navy, and in cases of desertion it can absolutely identify all suspects. This method of identification will also prevent soldiers from being buried in unknown graves in war time. Just investigate the number of soldiers who filled unknown graves as a result of the Civil War and you will see how valuable this means of identification is in time of war.

"On the Pacific coast they are using finger-prints as a means of identifying Chinese and Japanese depositors. Every time a Chinaman or Japanese wants to pay by check he puts his finger-print on the check instead of his signature (unless he can write English), and it takes but a second or two for the bank to tell the writer of the check. This system of finger-prints could well be adopted by banks as a means of protecting themselves against defaulting employees. Also the value for depositors who cannot write when depositing and withdrawing, using finger-prints in the place of signatures, is apparent.

"No employee would refuse to give his print, for by such refusal he would show dishonest intentions. As long as he is honest there is no harm done, but should he abscond with the bank's money, the bank has a sure means of strength of a photograph and his identity established beyond the shadow of a doubt by a photographic reproduction of his finger-prints.

ITS UTILITY TO LIFE INSURANCE COMPANIES

"In the same way insurance companies could protect themselves against fraud by having the person insured put his finger-print on his policy. Then

there would be no chance of another body being palmed off to get the insurance money, for the finger-print is the same in death as in life; it is the same from the cradle to dissolution.

FOR SECRET SOCIETIES.

"The issuing of receipts for dues with space in which the member's finger prints could be placed would be an absolute proof against imposition from people claiming membership in any organization.

Fraternal insurance societies requiring identification of deceased members by a committee of members of the order, could be assured of identification beyond a doubt even although the deceased had never been previously seen by any member of the committee."

FOR THE HOME.

"Every family will eventually file away the finger-prints of all the household, so that in case of fatal accident there will be no question of identity. Think of the worry that would be saved parents who have a child missing if they could leave the finger-print at a morgue instead of being compelled to visit that place every time anybody answering the description of their missing one is brought in."

THE MAKING OF WILLS.

"Think, also, of the great amount of squabbling over the validity of wills that would be eliminated if the person making the will attached his finger-print to it. Finger-prints offer innumerable opportunities for the prevention of fraud and crime and for the identification of missing people, whether criminals or not."

FINGER PRINTS vs. BERTILLON METHOD.

That the finger-print system is better adapted than the Bertillon method for identifying criminals, and that it will soon supplant that world-famous system, is the prediction of Henry Richardson, the finger-print expert in charge of the Massachusetts Bureau of Criminal Identification.

So great is Mr. Richardson's faith in the finger-print method of identification he states that, were the finger-prints of all the residents of Greater Boston classified—and he says that he could do this easily if he had the prints—he could, without name or photograph or Bertillon measurement, discover the identity of any resident in less than five minutes by means of a duplicate print.

Chairman Pettigrove, chairman of the Prison Commissioners, and under whose direction Agent Richardson is employed, sees great possibilities in the finger-print system and he is urging the police departments of all the towns and cities of Massachusetts to adopt it. Boston, Lowell, Somerville, Cambridge, Newton, Lexington, Brookline, Fitchburg, Waltham and Springfield have already done so.

In addition to the finger-prints being supplied the State Bureau, which acts in this respect as the centre for the police forces of the State, the State prisons and all the jails and houses of correction throughout the State are complying with the law and sending the finger-

prints of criminals committed to these various prisons, to the central bureau.

The State Identification Bureau also uses the Bertillon system, combining it with the finger-print, so that, it is said, there is at present not the slightest possibility of a mistake in identifying criminals.

It frequently happens that finger-prints taken after a prisoner's conviction lead to the discovery that a previous charge was on record, possibly under another name. A case in point was discovered in the Massachuestts Bureau recently by the agent. A murder was committed June, 1908, in New York City, and a negro who was awaiting trial for robbery in New Bedford, Mass., under an assumed name, and whose finger-prints were on file at the Massachusetts Central Bureau, was compared with photographic reproductions of his finger-prints, which were sent on by the New York Police Department, and by his finger-prints he was identified as the murderer, the negro in question having been previously arrested in New York, and his impression taken at that time.

The admirable, and at the same time simple, system of filing arranged in the Massachusetts Central Bureau, makes it possible for rapid reference to an immense number of cases, and a published gazette issued to the police departments through the whole United States from a central Bureau at Washington, D. C., giving a few figures and signs intelligible to police officials alone, would keep all these departments in touch with one another.

Having pointed out the uses to which the finger-print impressions can be applied, let us now proceed to look at their origin and for what purpose they are placed on the human finger, palms and foot-soles.

RIDGES—CREASES.

The palms of the hands and the soles of the feet are lined in all directions by depressions, and elevations of varying lengths, many of them grouped in designs or curvatures which, though seemingly complex, can be traced with exactitude.

The creases caused by the folding of the skin are most noticeable, and are found well developed in the new-born infant, the more numerous, though less noticeable lines, are the papillary ridges which appear over the whole surface.   There is, however, no connection between these two classes of marks.   The directions of the creases in no way determine the course of the ridges.

The ridges are full of pores, the mouths of the ducts of the glands which secrete the perspiration, and it is presumed that the office of the ridges is to raise the mouths of the ducts so as to assist and make easy the discharge of the sweat, and possibly also assist in some way the sense of touch.   The delicacy of these ridges in young children corresponds with the child's development, and they grow with the growth of the body, and are most marked in the hands of those who do some work, though liable to lose their sharpness of definition or even be partially obliterated where the hands become hardened from use of tools, etc.

A cut or other injury does not, necessarily, destroy the ridge, but leaves permanently a thin mark across the ridge which, when impressed, shows somewhat like a crease.

Besides the prominent creases like those which mark the divisions between the finger phalanges and those on the palm, creases not permanent may appear on the bulbs of the fingers, and not be perceptible in impres-

sions taken at different intervals of time, therefore un-
reliable for uses of establishing identity or otherwise.

PERMANENCE AND PERSISTENCE OF FINGER MARKINGS.

The usefulness of impressions taken for permanent
record must be contingent upon the persistence through
long periods of time covering the whole human life of
the general form of the design or pattern and of the
details of the ridges constituting it.   Mr. Galton, who
gives the results of his observations of impressions taken
from time to time at intervals from early childhood to
advanced age, says: "As there is no sign, except in one
case, of change during the four intervals of childhood
to boyhood, from boyhood to early manhood, from early
manhood to middle age, and from middle age to extreme
old age which altogether wholly covers the ordinary
life of man, we are justified in inferring that between birth
and death there is absolutely no change in say 699 out
of 700 of the numerous characteristics of the markings
of the fingers of the same person, such as can be impress-
ed by him wherever it is desirable to do so.   Neither
can there be any change after death up to the time
when the skin perishes through decomposition; for
example: the marks on the fingers of many Egyptian
mummies and on the paws of stuffed monkeys still
remain legible.

"Very good evidence and careful inquiry are thus
seen to justify the popular idea of the persistence of
finger-markings.   There appear to be no bodily char-
acteristics other than deep scars and tattoo marks com-
parable in their persistence to these markings; at the
same time they are out of all proportion more numerous
than any other measurable features.   The dimensions

NAME

F. P.

PRISC

RIGHT FORE FINGER PRINT   PRIS

RESIDE

BERTILLO

HEIGHT	1 M	HEAD. LEN'TH		L.
ENG. HGHT.		" WIDTH		L.
OUTS. A.	1 M	CHEEK		L.
TRUNK		RIGHT EAR { LENGTH		L.
CURV.		RIGHT EAR { WIDTH		

BERTILLON MEASUREMENTS TAKEN AT

SPACE I

NAME	
CRIME	
AGE	HEIGHT F
HAIR	E
COMPLEXION	
BORN	
OCCUPATION	ARRESTE

IMPRES

CLASSI

TESTED

PRISONER'S SIGNATURE

RESIDENCE

BERTILLON MEASUREMENTS

HEIGHT	1 M	HEAD. LEN'TH		L. FOOT			CIRCLE		AGE,	YEARS
ENG. HGHT.		" WIDTH		L. MID. F.			PERIPH. Z.			
OUTS. A.	1 M	CHEEK		L. LIT. F.		COLOR OF LEFT EYE			BORN IN	
TRUNK		RIGHT EAR { LENGTH		L. FOR A.			PECUL.			
CURV.		{ WIDTH								

BERTILLON MEASUREMENTS TAKEN AT   BY WHOM TAKEN

SPACE FOR PHOTOGRAPH

NAME		ALIASES	
CRIME		DISPOSITION	
AGE	HEIGHT FT. IN.		WEIGHT
HAIR		EYES	BUILD
COMPLEXION			MOUSTACHE
BORN			
OCCUPATION		ARRESTED BY	DATE

NAME			CLASSIFICATION		**MALE**

F. P. NO.   BER. NO.

PRISON

CLASSIFICATION: / A_A 5   *Filing No.* 19
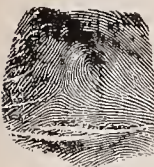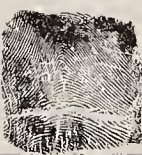
/ A_A 11

RIGHT HAND

RIGHT THUMB	R. FORE FINGER	R. MIDDLE FINGER	R. RING FINGER	R. LITTLE FINGER
\\	A	A	\\	\\

LEFT HAND

LEFT THUMB	L. FORE FINGER	L. MIDDLE FINGER	L RING FINGER	L. LITTLE FINGER
/	A	A	/	/

LEFT HAND PLAIN IMPRESSIONS   RIGHT HAND PLAIN IMPRESSIONS

IMPRESSIONS TAKEN BY	AT	PRISON	19
CLASSIFIED AT CENTRAL BUREAU BY	DATE		19
TESTED AT CENTRAL BUREAU BY	DATE		19

ONER'S SIGNATURE

.NCE

N MEASUREMENTS

FOOT			CIRCLE		AGE,	YEARS
MID. F.			PERIPH. Z.			
LIT. F.					BORN IN	
FOR A.			PECUL.			

COLOR OF LEFT EYE

BY WHOM TAKEN

FOR PHOTOGRAPH

ALIASES

DISPOSITION

| T. | IN. | WEIGHT |
| YES | | BUILD |

MOUSTACHE

D BY   DATE

of the limbs and body alter in the course of growth and decay; the color, quantity and quality of the hair, the tint and quality of the skin, the number and set of the teeth, the expression of the features, the gestures, the handwriting, even the eye color, change after many years.   There seems no persistence in the visible parts of the body, except in these minute and hitherto disregarded ridges.''

In speaking of the persistence of the marks on the fingers, the phrase must be taken to apply to the details of the ridges and to the general character of the pattern; not to the measure of its length, breadth or other diameter.

REASONS FOR TAKING "ROLLED" PRINTS

Though there is no difficulty in taking both impressions, taking "plain" is the simpler of the two, and therefore it may be desirable to see why a "rolled" impression is required.

Referring to finger-print impression sheet Plate 1

            1 A   19
            - — 5 — Filing No. —
            1 A   11

it will be observed that the whole patterns of the finger-print impressions are not so well defined in the plain impression of the fingers, as they are in the rolled impressions.   It is therefore easier to determine the type of pattern from a "rolled" impression, and the greater surface gives a larger number of points for comparison to be selected when it is a question of contrasting the details of two prints with a view to deciding whether they are impressions of the same or different digits.   In finger-print impressions of the whole pattern, there

being two deltas, it not infrequently happens that one,
or both deltas, are situated close to the finger nail.   As
it is necessary in tracing whorls that both deltas be visi-
ble, the importance of rolling the digit is apparent.

In Plate 2 we have finger-print impressions where
the right fore finger is missing.   The left fore finger is
an Ulnar loop with 11 ridge Counts, and in classifying
we have to assume that the right fore finger is the same
type of finger-print, containing the same number of

FIG. 1

ridges between the outer terminus and core, as is con-
tained in the right fore finger and the classification is
made on that assumption.   The classification therefore
is $_2\,^9\,_1\ \frac{U}{U}\ \frac{O}{O}\,\frac{O}{I}$.

Referring to figures 1 and 2 which are impressions
of the same thumb, it will be seen that in Fig. 1 the
whole contour of the pattern does not appear, whereas in
Fig. 2 the whole pattern is reproduced.   Obviously there-
fore, for reasons hereafter given, it is easier to determine

NAME

F. P. No.   BER. No.

PRISON

RIGHT H

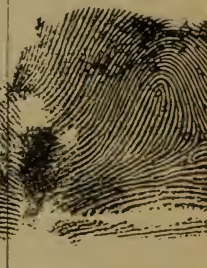| 1. RIGHT THUMB | 2. R. FORE FINGER | 3. R. MIDDLE FI |
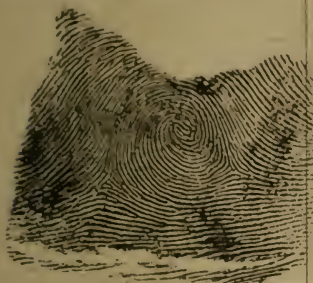
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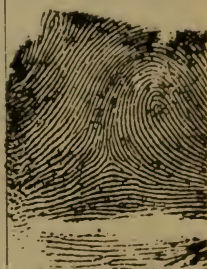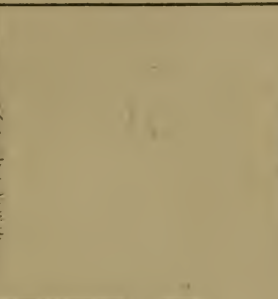
LEFT HA

| 6. LEFT THUMB | 7. L. FORE FINGER | 8. L. MIDDLE FI |

LEFT HAND

PLAIN IMPRESSIONS OF THE FOUR FINGERS TAKEN SIMULTANEOUSLY

IMPRESSIONS TAKEN BY   AT

CLASSIFIED AT CENTRAL BUREAU BY

TESTED AT CENTRAL BUREAU BY

NAME

CLASSIFICATION

$9 \, \mathcal{U} \left(\dfrac{OO}{} \right)$

$21 \, \mathcal{U} \left(\dfrac{OS}{} \right)$

MALE

F. P. No.

BER. No.

PRISON

RIGHT HAND

1. RIGHT THUMB	2. R. FORE FINGER	3. R. MIDDLE FINGER	4. R. RING FINGER	5. R. LITTLE FINGER
W	\		W	W

LEFT HAND

6. LEFT THUMB	7. L. FORE FINGER	8. L. MIDDLE FINGER	9. L. RING FINGER	10. L. LITTLE FINGER
/	/	/	/	/

LEFT HAND	RIGHT HAND
PLAIN IMPRESSIONS OF THE FOUR FINGERS TAKEN SIMULTANEOUSLY	PLAIN IMPRESSIONS OF THE FOUR FINGERS TAKEN SIMULTANEOUSLY

IMPRESSIONS TAKEN BY		AT	PRISON	19
CLASSIFIED AT CENTRAL BUREAU BY		DATE		19
TESTED AT CENTRAL BUREAU BY		DATE		19

| RIGHT FORE FINGER PRINT | PRISONER'S SIGNATURE |
| | RESIDENCE |

BERTILLON MEASUREMENTS

HEIGHT	1 M	HEAD. LEN'TH		L. FOOT		CIRCLE		AGE,	YEARS
ENG. HGHT.		" WIDTH		L. MID. F.		PERIPH. Z.			
OUTS, A.	1 M	CHEEK		L. LIT. F.				BORN IN	
TRUNK		LENGTH		L. FOR A.		PECUL.			
CURV.		WIDTH							

BERTILLON MEASUREMENTS TAKEN AT   BY WHOM TAKEN

(RIGHT EAR — LENGTH/WIDTH; COLOR OF LEFT EYE)

SPACE FOR PHOTOGRAPH

NAME		ALIASES	
CRIME		DISPOSITION	
AGE	HEIGHT FT. IN.		WEIGHT
HAIR	EYES		BUILD
COMPLEXION		MOUSTACHE	
BORN			
OCCUPATION	ARRESTED BY		DATE

the type of pattern from a "rolled" impression; more-over, the greater surface of the latter enables a larger number of points for comparison to be selected when it is a question of contrasting the details of two prints with a view to deciding whether they are impressions of the same, or of different digits.

FIG. 2

"PLAIN," "ROLLED" IMPRESSIONS—HOW TAKEN.

Impressions are taken in two ways, as "plain" and as "rolled" impressions. Fig. 1 is an example of the "plain," Fig. 2 of the "rolled" impression of the same thumb. (By "rolled" here is meant the cylindrical projection of the pattern upon paper.)

To take a "rolled" impression, the bulb of the finger is placed upon a piece of glass over which a thin film of printer's ink has been spread, the plane of the nail being at right angles to the plane of the glass, and the finger is then turned over until the bulb surface, which origi-

nally faced to the left, now faces to the right, the plane
of the nail being again at right angles to the glass.   By
this means the ridge surface of the finger between the
nail boundaries is inked, and by pressing it lightly upon
paper in the same way that it was pressed upon the
inked glass, a clear rolled impression of the finger sur-
face is obtained.   Care must be taken not to press the
finger too heavily on the paper, otherwise a blurred or
imperfect impression results.   To obtain good impres-
sions the following details must receive attention. The
glass in use should be free from dust, hairs or other
foreign matter.   It should be freshly cleaned each day,
all traces of the ink previously used being removed.
A very small quantity of ink should be applied, and
this should be worked up into the thinnest possible film;
unless the film is thin the impression obtained will not
be clear and sharply defined.   From a finger so inked
a good impression is secured, as even additional pres-
sure will not do much harm.   The paper used should
be white and its surface not too glazed, for unless it is
sufficiently absorbent, nearly all the ink will remain
on the finger, less adhering to the paper, the print result-
ing not being in consequence sufficiently dark.   Good
impressions can be taken on ordinary foolscap.   Stress
is laid upon the paper being white, so as to facilitate
the work of photographing, should a photograph of
the impression be, at any future time, required.   Many
kinds of ink have been experimented with, but, on the
whole, printer's ink is the most satisfactory, as it is
procurable everywhere at trifling cost.   The paper
being porous absorbs the ink impressed on it by the
finger, and as the principal constituent of this ink is
oily matter which readily oxidizes under the action of
the air,   the sheets containing impressions may be at
once handled without risk of defacement from smudg-
ing.   A "plain" impression is obtained by placing the

bulb of the finger on the inked glass and then impressing it on paper without any turning movements.

ALL IMPRESSIONS DIVISIBLE INTO FOUR TYPES.

Innumerable trials have been made with a view to fixing standards or types according to which all impressions can be readily sorted; Purkenje proposed nine, Mr. Galton three. As the outcome of much experimenting, a fourfold classification has been adopted which meets all requirements while greatly reducing the number of gradational cases.

These four types are: Arches; Loops; Whorls; Composites.

Definitions are given on pages 34, 40, 45 and pages 52 and 53 and following pages; numerous diagrams and illustrations being utilized to make the definitions intelligible.

FIXED POINTS IN IMPRESSIONS.

In impressions of the Loop, Whorl, and Composite types there are fixed points which, as will hereafter appear, subserve several useful purposes. These fixed points are:

(1) The "delta" or "outer terminus."
(2) The "point of the core" or "inner terminus.'

DELTA; "OUTER TERMINUS."

The "delta" here referred to may be formed either (A) by the bifurcation of a single ridge, Fig. 3, or (B) by the abrupt divergence of two ridges that hitherto had run side by side, Fig. 4.
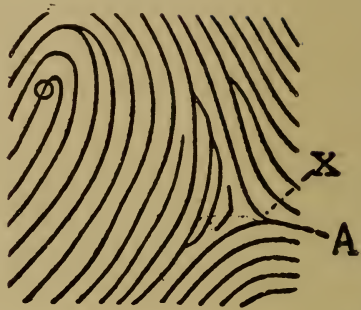
FIG. 4   FIG. 3

(*A*) Where the upper and lower sides of the "delta"
are formed by the bifurcation of a single ridge, the point
of bifurcation forms the "outer terminus," marked X
in Fig. 3.   Where there are several such bifurcations,
the one nearest the core is taken as the "outer terminus."

(*B*) The upper and lower sides of the "delta" may
be formed by the abrupt divergence of two ridges
which, up to this point, had run side by side.   The
nearest ridge in front of the place where the divergence
begins, even if it be a mere point, and whether it is inde-
pendent of or sprung from the diverging ridges or not,
is the "outer terminus," marked Y in Fig. 4.

CORE; POINT OF CORE; INNER TERMINUS.

The core of a Loop may consist either of an even or
an uneven number of ridges (termed "rods") not
joined together thus:

FIG. 5

or it may consist of two ridges formed together at their summit (termed "staple"), thus:

FIG. 6

Where the core consists of an uneven number of rods, the top of the central rod is the "point of the core." If the core is a staple, the shoulder of the staple that is

FIG. 7

farthest from the delta is taken as the "point of the core," the nearer shoulder counting as a separate

ridge.   Where the core consists of an even number
of rods, the two central ones are considered as
joined at their summits by an imaginary neck, and,
of these two, the shoulder farthest from the delta is
the "point of the core."   In Whorls circular or ellip-
tical in form, the centre of the first ring is the "point
of the core."   Where the Whorl is spiral in form, the
point from which the spiral begins to revolve is the
"point of the core."   "Point of the core" is synony-
mous with "inner terminus."

In the previous diagrams the first ridge that envelops
the core is dotted.

Illustrations 149 to 164 inclusive have the "inner
terminus" (I.T.) and "outer terminus" (O.T.) drawn
under each impression.   Study of these illustrations
will, it is hoped, make the definitions quite intelligi-
ble.   As explained under *ridge counting*, Loops are
differentiated according to the number of ridges which
intervene between their "inner" and "outer terminus,"
these *two terminal points being excluded from the count.*

FIG. A   FIG. B   FIG. F.

Figures A and B are Whorls of the spiral variety.
Fig. C is a Radial Loop, if it is a right hand digit,
figures D and E Ulnar Loops as will be seen by examin-
ation, being right hand digits.   The lines of the ridges
run towards the thumb in figure C, while in figures D
and E the ridges run towards the direction of the little
finger.

| FIG. C. | FIG. D. | FIG. E. |
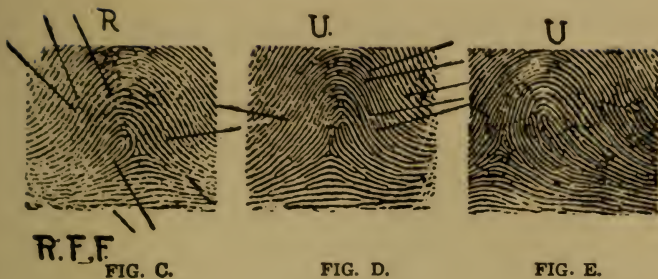
Whorls present a variety of phases which include central pocket loops, lateral pocket loops (see Fig F), twinned loops and accidental patterns.

Fig. D. Loop. The lower black line on the right of the pattern points to an island, the line above shows an abrupt termination of two ridges which run parallel up to this point, and the other black lines including the line on the left side of the pattern points to bifurcation of ridges. Many other bifurcations, short ridges or ridges coming to an abrupt termination, islands, etc., may be seen and noted by careful examination of finger prints.

| ARCH | ARCH | T. A. |

ACCIDENTAL
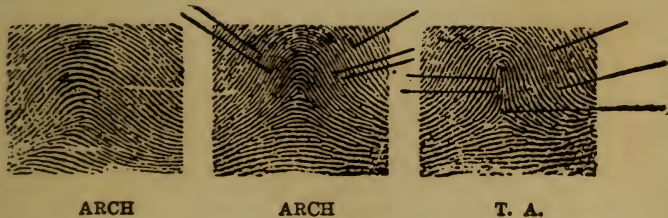
CLASSIFICATION OF IMPRESSIONS.

In order that all impressions may be readily classified, many trials have been made with this object in view to adopt fixed standards or types so that the impressions can be quickly sorted. The eminent authority on "finger-prints," Professor Purkenje, professor of physiology and pathology in 1823, read a Latin thesis before the University of Breslau suggesting a system of classification giving nine standard types, and Mr. Francis Galton proposed three standard types. After much experimenting, a fourfold classification has been adopted which meets all requirements, while greatly reducing the number of gradational cases.

ARCHES.

The ridges in arches run from one side to the other, and make no backward turn: there is ordinarily no delta, but, when there is the appearance of a delta, *no ridge must intervene between the "inner" and "outer terminus."* Figures 8 and 9 present no difficulty.

FIG. 8
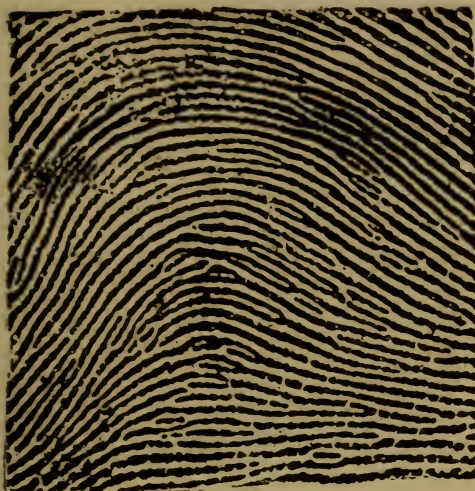
FIG. 9
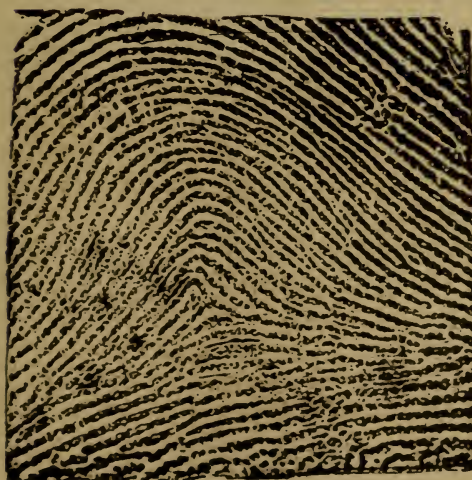
FIG. 10
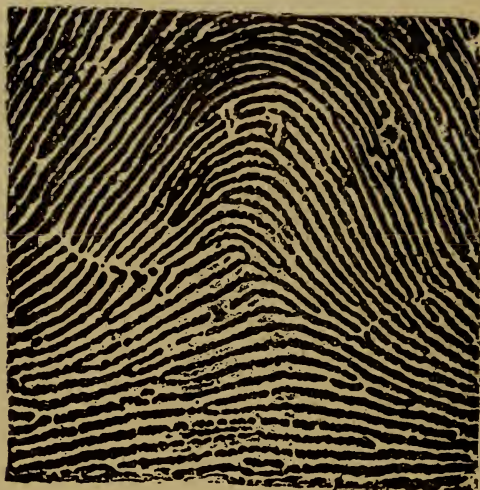
FIG. 11

In figures 10 and 11 there is in each one ridge which has the appearance of recurving, and it might be contended that these impressions are of both the "Loop" and "Arch" types: but when the above definition is applied, it will be seen that as no ridge comes into count between the two terminal points, they fall within the class of Arches and might be designated as an arch approximating a loop.

The impressions given in illustrations 1 to 12 inclusive are arches, as shown under Arches on page 108. In Illustrations 13, 14, 15 one ridge, page 108, in illustration 16 two ridges are interwoven between the terminal points: these impressions are therefore Loops and not Arches, all of which are shown on page 108.

FIG. 12

FIG. 13

TENTED ARCHES.

In patterns of the arch type, the ridges near the middle may have an upward thrust, arranging themselves as it were on both sides of a spine or axis, towards which adjoining ridges converge. The ridges thus converging give to the pattern the appearance of a tent or outline, hence the name "Tented Arch" (Fig. 13) on page 37.

In order to demarcate clearly the line which separates Tented Arches from those Loops whose ridges have a more or less vertical trend, it is held that, if *on either side of the axis even one ridge recurves,* the impression is a Loop (Fig. 12). The meeting of two ridges at a sharp angle resulting from their running into each other through not maintaining their parallelism of direction, is not to be confused with recurving. The recurving ridge must be wholly on one side of the axis. Illustrations 17 to 24, page 108, are Tented Arches. Illustration 25 has one recurring ridge to the right of the axis; Illustration 26, page 109, has one to the left (some converging ridges may be noticed in this impression); Illustration 27, page 109, has two recurring ridges at least, to the right of the axis, so these impressions 25, 26, and 27 would be classed as Loops.

LOOPS.

In Loops some of the ridges make a backward turn but without twist; there is one delta (Fig. 14, 15) page 40. In Fig. 15 the ridge, or, if it is likened to water, the stream AX bifurcates into XC and XD. XC at first follows an upward course, and having reached its greatest

height, trends downwards, passing away to the left side, while XD proceeds generally in the direction followed by AX; there is one delta, namely, at X. The trend of the ridges about the core, i. e. the direction from their summit to their exit between CD, is a slope from the right of the person looking at them towards his left.

In Fig. 16 some of the core ridges meet an enveloping ridge at an acute angle; compare Illustrations 44, 45, 46, 47, 48, 49. In Fig. 17 the summits of the ridges are deflected slightly downwards; compare Illustrations 35 and 36.

The Illustrations 28 to 49 inclusive exhibit many varieties of Loops, and may be studied with advantage.

ULNAR AND RADIAL.

When seen in a looking-glass, the right hand appears as a left hand, the right eye as a left eye and so on. Similarly, the print of a finger is a reversal of the pattern on the finger; if this pattern on the finger be a Loop with slope from left to right, it will appear in the print as a Loop with slope from right to left. If a finger print impressed on transparent paper be held in front of two persons facing each other, the pattern as seen by one will be a reversal of the pattern as seen by the other; all the details of the print will correspond, but to one observer the ridges which lie to the left of a central line will appear to the other observer to lie to the right. This is precisely what occurs when the same pattern exists on corresponding fingers of the two hands, as may be seen by taking prints from the two fingers, when it will be observed that one print delineates a pattern which is a reversal of the pattern delineated by the other. This must be remembered and taken into ac-
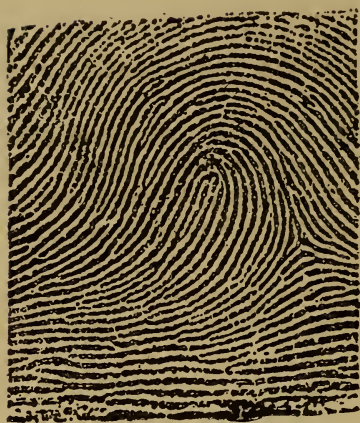
FIG. 14

FIG. 15

FIG. 16

FIG. 17

count in determining whether a Loop is *ulnar* or *radial*. A Loop is *ulnar*—U when the downward slope of the ridges about the core is from the direction of the thumb towards that of the little finger, and it is *radial*—R when the downward slope is from the direction of the little finger towards the thumb.

The following rule may always be usefully applied. When the print under examination is that of a right hand digit, place the right palm on the table; if the downward slope of the ridges about the core is from the thumb side towards the little finger the Loop is *ulnar*, and if the slope is from the direction of the little finger towards the thumb it is *radial*. If the print is that of the left hand digit, place the left hand palm on the table, and the same rule applies.

Using the symbol ╲ for *ulnar* and ╱ for *radial* in the right hands, these symbols will be reversed for the left hand, where ╱ = *ulnar* and ╲ = *radial*. If the impressions of Figs. 14 and 15 are those of a left hand digit, they are *ulnar* Loops; if of a right hand digit they are *radial* Loops.

Referring to the Illustrations, if they are impressions of a right hand digit, 31, 32, 35, 37, 42, 46 are *ulnar* Loops, 30, 33, 34, 38, 39, 40, being *radials*.

If they are impressions of a left hand, 31, 32, 35, 37, 42, 46 would be *radial*, and 30, 33, 34, 38, 39, 40, would be *ulnar*.

As it is essential to have this point clearly understood and borne in mind we make the above special explanation.

WHORLS.

In whorls some of the ridges make a turn through at least one complete circuit; there are two deltas.

Whorls are single cored or double cored (Figs. 18, 19, 20, 21, 22, 23).

In Fig. 18 the ridge or stream AY bifurcates at Y, the stream YB making an upward turn before descending, while the stream YC passes away towards the right side, this bifurcation causing the appearance of a delta at Y. On the right side of this same diagram the stream DZ, which flows from right to left, bifurcates at Z, causing the appearance of the delta there; the stream ZE at first flows upwards before taking a downward course, while the stream ZF, continuing in the direction of the parent stream DZ, passes away to the left.

In Fig. 20 the ridges about the core are elliptical in form. Fig. 21 exhibits a single spiral whorl. Fig. 22 a double spiral. Fig. 23 is that of an impression which may be called almond-shaped. In some patterns the spiral appears to revolve in the same direction as the hands of a watch, in others this revolution is in the opposite direction; great variety is noticeable in the cores; and very many details force themselves upon consideration when two impressions of this type are being compared.

Varieties of the whorl type are delineated in Illustrations 101 to 124 inclusive.

COMPOSITES.

Under this head are included patterns in which combinations of the Arch, Loop, Whorl are found in the same print, also impressions which might be deemed to present features requiring their definition as being Loops in respect of the majority of their ridges and Whorls in respect of a few ridges at the centre or side. These are subdivided into Central Pocket Loops, Lateral Pocket Loops, Twinned Loops, and Accidentals.

FIG. 18

FIG. 19
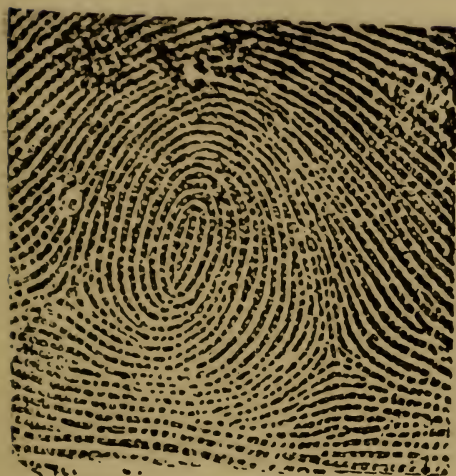
FIG. 20
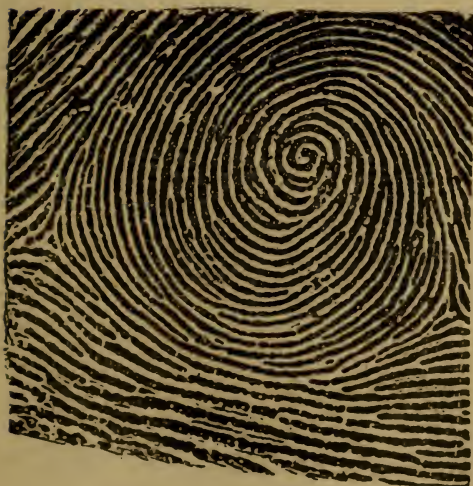
FIG. 21

FIG. 22

FIG. 23

CENTRAL POCKET LOOPS.

It frequently happens in patterns of the Loop type that the ridges immediately about the core deviate in course from the general course of the other ridges. Such impressions may therefore be said to possess features which require their being defined as Loops in respect of the majority of their ridges and Whorls in respect of the appearance of the few ridges which occupy a space immediately about the centre, a delta more or less faintly defined having in consequence made its appearance.

Using a name adopted in mining, a space so occupied by ridges whose course deviates from the course of the ridges surrounding them is described as a "Pocket," and the impression as a Central Pocket Loop (Figs. 24 and 25.)

All varieties of the Central Pocket type can be arranged under one or other forms of Core shown in Fig. 26. These four standards overlap; II is obviously only a modification of I, and III a more complete form of IV. The arrow marks the position of the axis or line of exit of the ridges. Examining the standard, it will be noticed that this arrow if prolonged would meet at least one recurring ridge at right angles. This characteristic determines in doubtful cases whether an impression is a Loop or Central Pocket.

These standards have been adopted to guide the eye, and because their employment often proves of assistance in at once deciding whether an impression is a Central Pocket or not.

Illustrations 71, 72, 73, 74 come under standard I; in 75, 76, 77, 78 the axis meets ridges not at right angles but at an acute angle, and they moreover are converging not recurring ridges, so these impressions are excluded from Central Pockets and classed as Loops.
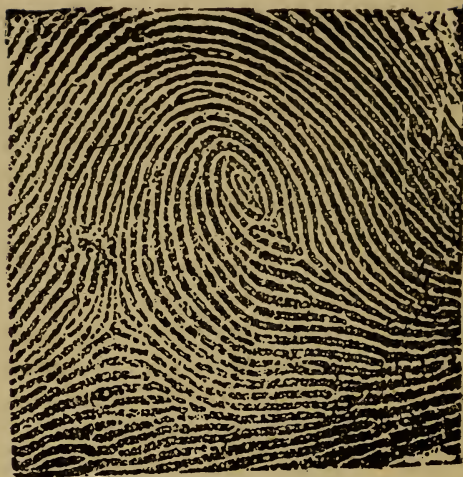
FIG. 24

FIG. 25
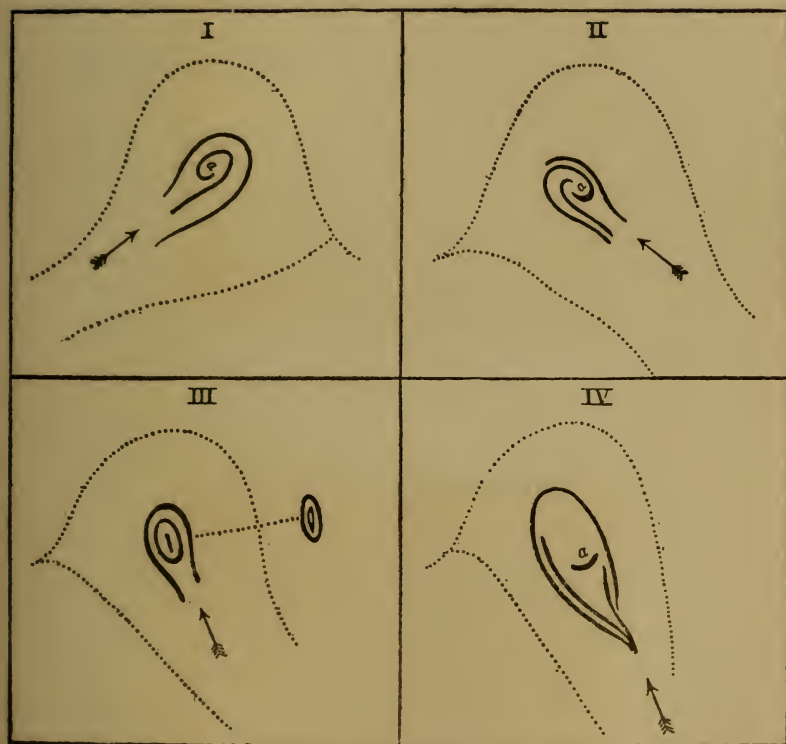
FIG. 26

Illustrations 79, 80, 81 come under standard II. In Illustrations 82, 83, 84, 85 the ridge or ridges meet the axis at an acute angle; these impressions are classified as Loops. Standard III. possesses characteristics which can at once be noticed when they exist in an impression.

Standard IV. is the most comprehensive and most easily applied. The existence of even one ridge whose course is at right angles to the axis brings the impression under this standard.

Illustration 97 is a good example of this; 99 is a doubtful case, but, as figured, it falls according to the rule under Central Pockets. There will occasionally occur cases in which the application of the rule may appear doubtful, and those must be treated as transitional, and when search is made it must be made first on the assumption that the impression is a Loop, and then on the assumption that it is a composite; but this will be more fully dealt with under classification.

LATERAL POCKET LOOPS.

When the ridges constituting the Loop bend sharply downwards on one side before recurving, thereby forming on that side an interspace or "pocket," ordinarily filled by the ridges of another Loop, such impression is termed a Lateral Pocket Loop. In Fig. 30A compare 1, 2, 4, 5; the outline of the Loop, whose ridges bend down sharply, is shown by the dotted lines, the thick dark line (a) represents its central ridge, the dark line (b) representing the central ridge of the Loop where ridges occupy the pocket. See also Figs. 27, 28, 29, 30, also Illustrations 50 to 57 inclusive. It should be realized that the ridges which bend downwards must be recurving not converging ridges—that their contour when they recurve must be rounded not angular. These

ridges in Illustrations 58 to 65 inclusive converge, that is, they meet at an angle, and their contour in consequence is angular not rounded, hence the impressions would be classified as Loops *ulnar* or *radial* and not as Lateral Pockets.

TWINNED LOOPS AND LATERAL POCKETS DIFFERENTIATED.

Referring to Figs. 31 and 32 and Illustrations 66, 67, 68, 69, 70, it will be seen that this at first sight complicated pattern in reality consists of two well-defined Loops, one superincumbent on or surrounding the other. Such an impression is termed a Twinned Loop.

Many Twinned Loops appear to be almost identical in contour and in details of ridge grouping with Lateral Pockets. Fig. 30A contains patterns which make clear the destination which exists. The dark lines, marked *a*, *b*, are the central ridges of the two Loop systems, the ridges which contain the "points of the core." In 1, 2, 3, 4, 5, Fig. 30A, these ridges *a*, *b*, have their exits on the same side of the right hand delta. In 6, 7, 8, 9 these ridges have their exits on different sides of the right hand delta. The following distinction therefore differentiates Lateral Pockets from Twinned Pockets. In Lateral Pockets the ridges containing the "points of the core" *have their exits on the same side of the right delta*; in Twinned Loops the ridges containing the "points of the core" *have their exits on different sides of the right delta*. Both types of pattern are, as already stated, included under Composites, and further differentiation may appear unnecessary; but in practice it will be found very useful to have such a clear distinction between patterns which in general appearance closely resemble each other.

FIG. 27
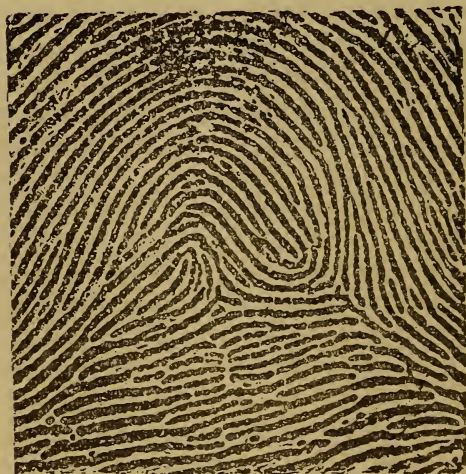
FIG. 28
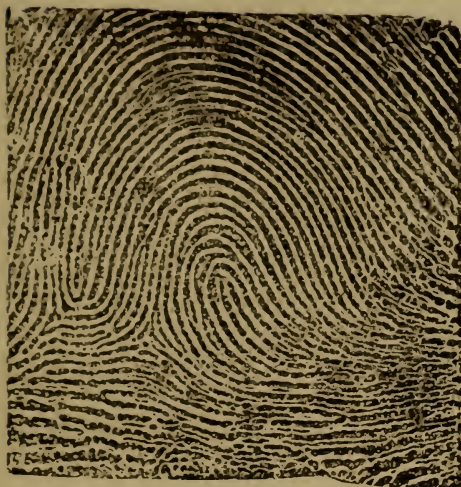
FIG. 29

FIG. 30
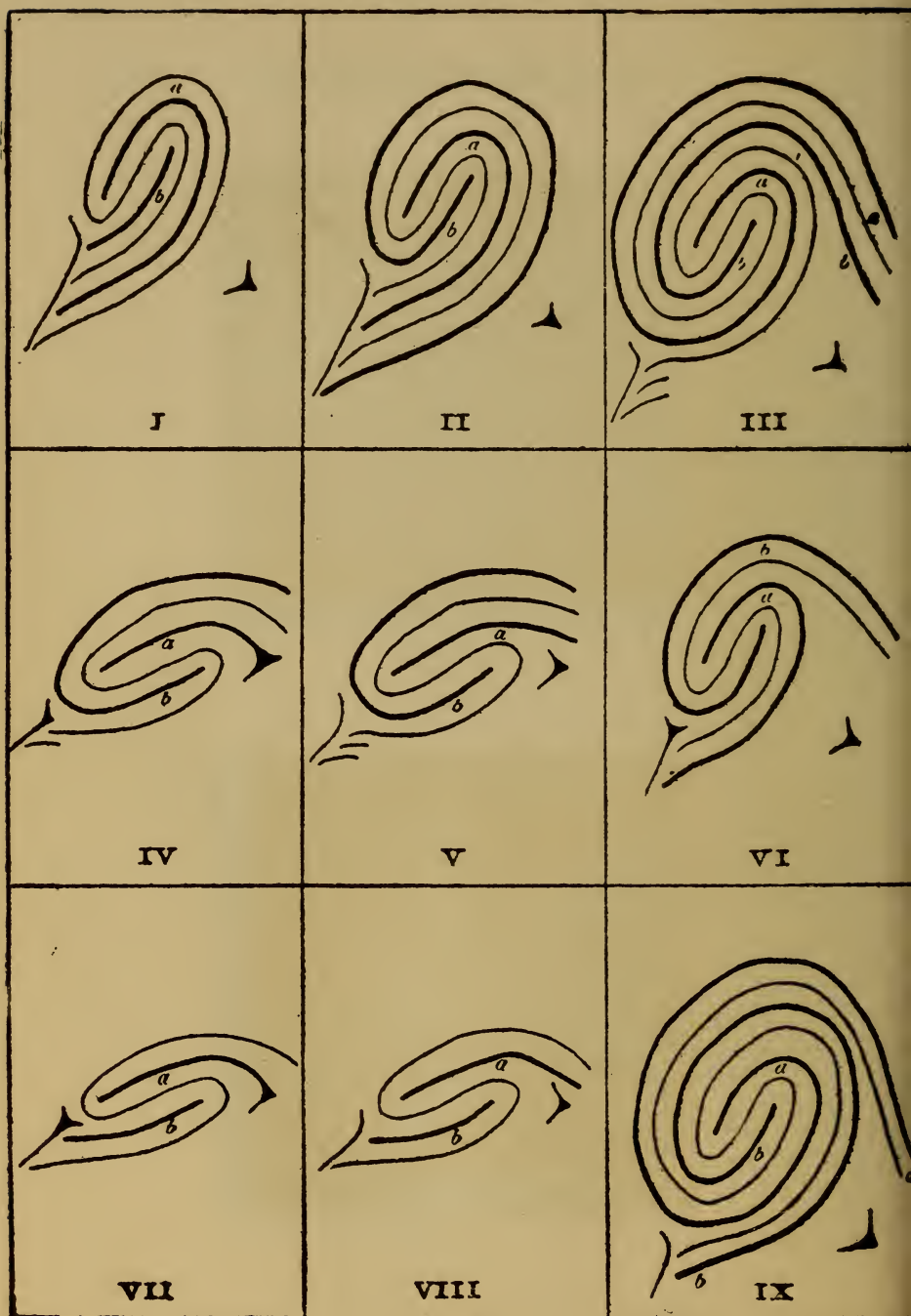
FIG. 30 A

FIG. 31

FIG. 32

ACCIDENTALS.

Under composites are also included the relatively small number of patterns too irregular in outline to be grouped under Central Pockets, Lateral Pockets, or Twinned Loops; they are termed for want of a better name Accidentals (Figs. 33, 34, 35, 36 and Illustrations 125 to 132 inclusive). Fig. 33 might be described as an arch with pocket.

Fig. 34 at first sight, appears to be a whorl surrounded by a Loop; Illustration 127 to be a Whorl resting on a Loop; 130 a Loop resting on a Whorl; but stricter examination shows that such descriptions lack accuracy, and it is better therefore to group these varieties into subclass accidentals of class Composites.

FIG. 33
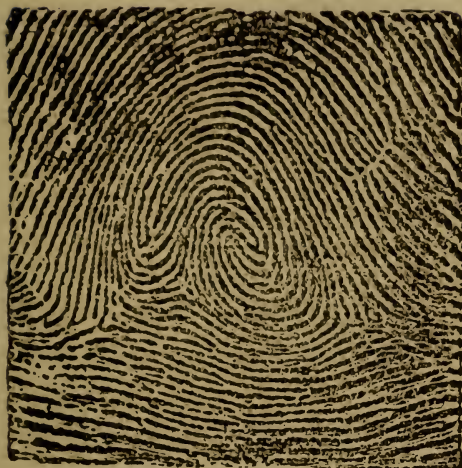
FIG. 34
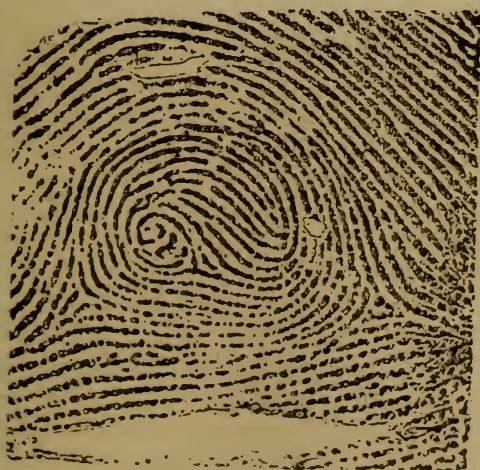
FIG. 35

FIG. 36

RIDGE COUNTING.

As about two impressions out of every three are
Loops, the subdivision into *ulnar* and *radial* fails to split
them up into groups sufficiently small, and it is neces-
sary therefore to still further differentiate them by other
methods.

Fig. 37 represents the ridges of an ordinary Loop.
The line SB joins the two terminal points, "inner" and
"outer terminus." If the ridges which cut the line SB
are counted they will be found to number 17, so this
Loop is specialized as a Loop with 17 ridges or *counts*,
and if it is the impression of a right hand digit it would be
further specialized as an *ulnar*; if of a left hand digit as
a *radial* Loop. In *counting* it must be remembered that
the *two terminal points are excluded from count*, that
ridges like G, which run close up to without meeting

FIG. 37

the line SB are also excluded, and that when two ridges result from a bifurcation as at D, close to the line SB, both are counted. A little practice will enable anyone with the help of a reading glass and a pointer to *count* ridges accurately and quickly.

Illustrations 149 to 164 inclusive may be studied; the "inner" and "outer terminus" are figured below each impression, and the number of *counts* given.

RIDGE CHARACTERISTICS.

If Fig. 37 be again more closely examined, many other details of the ridges will be noticed. The "core" is a "staple" whose right limb bifurcates at B, and whose left limb bifurcates at D and again at E. In the ridge which immediately surrounds the core ridge is a small island to the left of D, and another in the third surrounding ridge directly above A. These islands come out clearly in the diagram, but in actual impressions they might appear as a bulging out or thickening of the ridge, due to the ink running. At G the ridge begins abruptly and ends abruptly at H, at K another

ridge begins abruptly, at L another ridge bifurcates, at O another ridge begins abruptly, and there are many other similar details. These abrupt beginnings and endings, islands, bifurcations, etc., are known as ridge *characteristics*. Each marked departure from the general system of reticulation may thus be utilized.

Whorls and Composites present such innumerable varieties of pattern and of *characteristics* that when two whorls are compared no difficulty is experienced in determining whether they are impressions of the same or of different fingers. But as it proves convenient to have them subdivisible into regular groups, the system employed may be described.

RIDGE TRACING.

In all impressions of the above two types there are two deltas, one to the left and the other to the right. These deltas are formed either by the bifurcation of a single ridge, or by the sudden divergence of two ridges that up to this point had run side by side. Taking the lower limb or lower ridge of these two, its course is followed, and it will be found either to meet, to go inside or go outside the corresponding ridge of the right delta. When the ridge whose course is being *traced* stops short, the course of the ridge next below it is followed; when the ridge bifurcates, the *tracing* proceeds along the lower line of bifurcation. When the ridge whose course is *traced* meets the corresponding right delta ridge the whorl is specialized as M; when this ridge goes inside, it is specialized as I, when outside as O.

To secure an even distribution of I, M, O whorls it has been found necessary to provide that if the ridge whose course is *traced* goes inside or outside the right delta ridge with not more than two ridges intervening

between them, such ridge is considered as though it actually met the corresponding ridge. I therefore means that the left delta ridge goes inside the right delta ridge, there being between them not less than three inter-vening ridges; O means that the left delta ridge passes outside the right delta ridge, not less than three ridges intervening; and M means that the ridge whose course is *traced* actually meets the corresponding ridge, or that they are not apart by more than two intervening ridges. The definitions will be readily understood from the drawings below, where the ridge course *traced* is marked by the arrow heads.

FIG. 38

SUMMARY OF PRECEDING PARAGRAPHS.

What has been said on previous pages may now be briefly summarized. The palmar surface of the hand and the sole of the foot are traversed by innumerable ridges, forming many varieties of patterns and by creases. The ridge patterns and the ridge *characteris-*

tics persist throughout the whole period of human life, and are so distinctive as to differentiate each individual from all others   An accurate reproduction of these ridges is obtained by inking the finger bulb and pressing it on paper, the impression thus recorded being a reversal of the pattern on the finger.   All impressions may be arranged under four types, namely, Arches, Loops, Whorls, Composites.   Arches subdivide into Arches and Tented Arches; clear definitions demarcate Arches from Tented Arches, and both from Loops. Loops may be *ulnar* or *radial*, and are further differentiated from each other by ridge *counting* and by their ridge characteristics.   Whorls are single or double cored; impressions of this type differ conspicuously from each other, owing to the innumerable varieties of pattern they present, but further demarcation is provided by ridge *tracing*.   Composites include Central Pockets, Lateral Pockets, Twinned Loops, Accidentals; the definitions given are sufficient for the accurate differentiation of these subclasses.

In impressions there are fixed points known as "inner" and "outer terminus" whose correct position is readily found.   These fixed points serve many useful purposes, including ridge *counting*, ridge *tracing*, and the orientation of patterns.

SYMBOLS USED.

The symbols used are A— Arch; **T** — Tented Arch; **L** — Loop; **W** — Whorl; C — Composites; LP — Lateral Pocket; TL — Twinned Loop; CP — Central Pocket; AC — Accidentals; IT — "Inner Terminus"; OT — "Outer Terminus"; U — ╲ — *ulnar* in right hand; R — ╱ — *radial* in right hand; U — ╱ — *ulnar* in left hand; R — ╲ — *radial* in left hand.

PRACTICAL ILLUSTRATION OF USE OF SYSTEM.

The facts of a notorious criminal case decided in the Bengal, India, courts in 1898 illustrate how finger-prints may be used in practice.

"The manger of a tea garden in the district of Julpaiguri on the Bhutan frontier was found lying in his bed with his throat cut, his safe rifled and his money carried away. As the deceased was known to be a hard taskmaster it was thought that one of the garden coolies committed the murder, or that his cook, whose clothes showed blood spots, might be the culprit. There was suspicion also against the relatives of a woman with whom the murdered man had a *liaison*, also against a wandering gang of Kabulis who had likely encamped in the vicinity. A representation was also made that the deceased had an enemy in an ex-servant whom he had caused to be imprisoned for theft. After inquiry the Police satisfied themselves that there was no evidence to incriminate either the coolies, or the woman's relatives or the vagrant Kabulis, and it was found that the ex-servant had been released from jail some weeks before but none could say he had been seen in the neighborhood. The cook's statement that the blood marks on his clothes were stains from a pigeon's blood which he had killed for his master's dinner was supported by Chemical Analysts' report.

Among the papers in a dispatch box which had been rifled was found a calendar in book form, printed in the Bengali character, with an outside cover of light blue paper on which were noticed two faint brown smudges. Under a magnifying glass one smudge was decipherable as a portion of the impression of one of the digits of some person's right hand. In the Central office of the

Bengal Police, the finger impressions of all persons con-
victed of certain offences are classified and registered,
and the impression on the calendar when compared was
found to correspond exactly with the right thumb of
Kangali Charan, the ex-servant above referred to   He
was arrested at Birbum some hundreds of miles away
and brought to Calcutta where his right thumb print
was again taken, the police meantime were collecting
corroborative evidence.   The government   chemical
examiner certified that the brown marks on the calendar
were   mammalian blood, the inference being that the
actual murderer or some associate had knocked his
blood stained thumb against the book when rummaging
amongst the papers in the despatch box looking for the
safe key.   The accused was committed to stand trial
before a judge and assessors, charged with murder and
theft, and finally was convicted of having stolen the
missing property of the deceased, the assessors holding
that it would be unsafe to convict him of murder as no
one had seen the deed committed, but recording their
opinion that the theft charge had been conclusively estab-
lished against him.   This conviction was upheld by the
judges of the supreme court to which the case was taken
on appeal."

Now to apply the above case for practical use.   Figs.
39, 40, 41 are copies of the enlargements made from the
marks by the survey of India, placed before the courts
that tried this case, and proved in the usual way.   Fig.
42 is a drawing by hand to show the ridge *characteris-
tics* relied on; they are marked by small capital letters,
and are fully described.

They appear in all three impressions—in the blood
print on the calendar (Fig. 41), in the print on record
in the Central Police office (Fig. 39), and on the print
taken from Kangali Charan's thumb after his arrest
(Fig. 40).

FIG. 39

FIG. 40
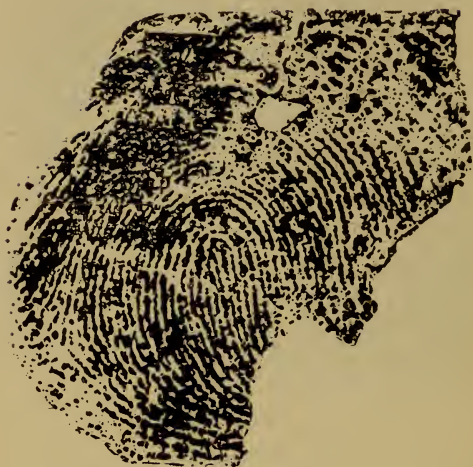
FIG. 41
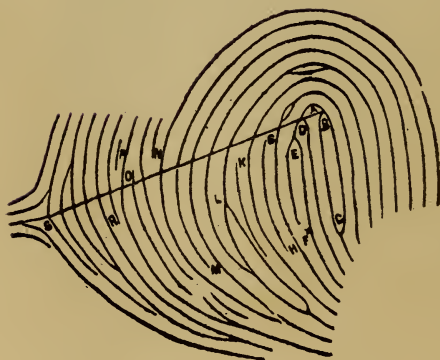
FIG. 42

What probative value shall we assign to such distinctive similarities being found in three prints made at intervals of time, and what inference are we in the circumstances of this particular case justified in drawing? The question is of such importance that some space should be devoted to discussing it.

PROBATIVE SIGNIFICANCE OF EXISTENCE IN TWO FINGER PRINTS OF DISTINCTIVE SIMILARITIES.

It is known that many of the constituents of the sun and stars have been determined by spectroscopic analysis of the light from them which comes to us as a message through space. Transmitted through a glass prism, light so simple in appearance, but in reality complex in its nature, is resolved into its constituent rays, these appearing a band of various colours with narrow gaps wanting in brightness which show out as dark lines traversing the colours of the spectrum.

For nearly half a century after their first discovery by Fraunhoffer their significance was not apprehended, and it was only in 1859 that Kirchoff proved the dark lines of the spectrum to be caused by the absorbing power of a vapour screen of the same substance which when sufficiently heated gives out the bright lines. This discovery provided a key which has enabled astronomers to solve many problems which hitherto had baffled them. The spectra of earthly elements having been mapped out, it was possible to compare them with the spectra of the sun and stars, and then marked coincidences in the number, position, and groupings of these lines became apparent. By what process of reasoning are such coincidences held to establish the identity of the sources producing these coinciding lines? The answer is given in the published results of Kirchhoff's in-

vestigations. On comparing the spectrum of sunlight
and of light from incandescent iron vapour, he found a
considerable number, sixty or more bright lines in the
spectrum of iron coinciding with dark lines in the solar
spectrum. Taking the average distance between these
lines as they show on his map, and making allowance
for their apparent breadth, he considers the probability
to be ½ that an iron line thrown down by chance will
appear to coincide with a solar line. The probability
of casual coincidence of each iron line with a solar line
is similarly ½ . The probability therefore of coinci-
dence by chance of all sixty iron with the sixty solar
lines is ½ multiplied by ½ sixty times or (½) 60.
Otherwise expressed, the odds against these coincidences
occuring by chance is more than a trillion to one. On
the supposition, however, that iron exists in the sun, it
is certainly probable that such coincidences would be
found.

This argument is held to establish with a probability
little short of certainty the existence of iron in the sun.
Many other conclusions of astronomy are based upon a
similar application to the theory of probability.

Upon like grounds we believe in the human origin of
flint heads. For though the actual concussion of one
flint against another may produce flakes, yet when
several such flint heads are found in the same spot, each
bearing evidence of many blows similarly directed, con-
ducing to fashion a lance or spear-head form, the prob-
ability of a natural origin becomes extremely small, and
the supposition that they are the handiwork of men
almost a certainty.

We may now apply this line of reasoning in estimat-
ing the probability of specified *characteristics* found in the
impression of one digit occuring by chance in that of
any other. Taking Fig. 42 and assuming it to be three
chances to one against the bifurcation B occuring casu-

ally in this particular limb of a "staple" and at this particular point of it in another impression selected at random. the probability of such occurrence is ¼. The degree of probability here assigned is, it will be conceded, not excessive, for there might be no bifurcation, or if there happened to be a bifurcation it might be in some other position of the limb   Similarly, the probabilty of bifurcations at D and E occurring by chance is ¼ for each; the probability of a ridge beginning abruptly at G may be put down at ¼; of its ending abruptly at H at ¼; of ridges beginning abruptly at K, M, N, each at ¼; the chance of another impression being an *ulnar* Loop each at ¼; the chance of another impression being an *ulnar* Loop with a "staple" for core at ¼; and finally, the probability of a second impression having just 17 ridges intervening between its "inner" and "outer terminus" at ¼, and so on. Confining our attention to the *characteristics* specially noticed, the probabilty of all ten occurring by chance in the impression of any other digit is ¼ multiplied by ¼ ten times, or (¼) 10. In other words, the odds against all these similarities being found in two impressions, not those of the same digit, is over a million to one.

Upon the other hypothesis that they are prints of the same digit it is highly probable that such coincidences would occur, and clearly it is immensely more probable that these ten coincidences in the *characteristics* of the ridges should be found if the impressions are those of the same digit than that they should occur by chance. Figs. 39 and 40 are printed from the same thumb, the one taken in 1895, the other in 1897; they show all the *characteristics* which have been enumerated, and these same *characteristics* are found in the blood print on the calendar, proved to have been in the possession of the deceased from the time of its issue.

It may happen that circumstantial evidence of

apparently overwhelming completeness will sometimes lead to a mistaken judgment, but every court has to act on probabilities, for if certain evidence, in the strict meaning of the words, were required, no punishments could be inflicted   While, then, realizing the importance of carefully distinguishing between truth of a theory and its truthful application to the facts of a case, can there in this instance be any doubt that the blood print on the calendar is the thumb impression of Kangali Charan?

SOME METROPOLITAN POLICE DEPARTMENT EXAMPLES.

On the 17th August 1904, a thief entered No. 30 St. Peter's square, Hammersmith, and before leaving helped himself to a glass of wine. On the tumbler used the thief left two finger-prints, and these were subsequently found, upon search in the Record at New Scotland yard, to be identical with two of the finger prints of one George Gage a noted thief.

Gage was arrested and tried.   He pleaded guilty, and was sentenced to four years penal servitude.

This case was reported at length in the *Daily Telegraph* of October 21st, 1904.

Another case.   On 29th November 1904, a burglary took place at No. 5, Crisp street, Poplar.   Entry was effected by means of removing a pane of glass from basement window.   On the glass taken out were imprints of a right forefinger, right middle finger, left thumb, left forefinger, and left middle finger, all in their natural sequences.

The patterns of the imprints were those of *u'nar* Loops, with the exception of the left thumb, which was a whorl.   There was also a distinct whorl imprinted on

the glass, and by its size it was thought to have been made by the thumb. Amongst the files searched was 5-17, which is the formula when both thumbs are whorls and the remaining digits Loops, and in it the finger prints of one Walter Rose were found to agree with the impressions left on the glass.

Rose was arrested and some of the stolen property found at his abode. In this case only a few hours elapsed after Police were informed before the thief was located and arrested.

Rose pleaded guilty.

This case was reported in the *Morning Advertiser* of 21st December 1904. The above cases afford a useful lesson of the value of keen inspection of all articles and premises where burglaries have taken place.

When finger-prints are needed as exhibits in cases, it is often necessary to have photographic enlargements made, so that the magistrate, judge or jury, may be able to see for themselves the similarities or dissimilarities in impressions which are relied on in the case. Such enlargements to be admissible must be proved in the manner laid down by the Law of Evidence, the provisions of which should be consulted by officers concerned in conducting cases in which finger-prints are exhibits. According to the existing law, the testimony of finger-print experts is admissable and relevant.

COMPARISON OF ANTHROPOMETRIC AND FINGER PRINT SYSTEMS.

The system of identification by finger-prints proving so satisfactory to the officials of the Bengal, India, District that in 1897 application was made to the Government of India to appoint an independent committee to enquire into and report upon the system and General

Strahan R. E., Surveyor General of India, and Mr.
A. Pedler F. R. S., Director of Public Instruction and
formerly Head of the Bengal Meteorological Department,
were selected to form a committee. Towards the end
of March 1897 they enquired into both the anthropometric
and the Finger-Print Systems and submitted a Report
in which the strong and weak points in both systems
were thus compared—

	Anthropometry		Identification by Finger Prints
1	Instruments are costly and liable to get out of order.	1	Accessories needed, a piece of tin and some printers' ink, are inexpensive and procurable everywhere.
2	Measurers must be put through a special course of instruction and be possessed of sufficient education to understand the significance of the figures of the decimal scale.	2	Any person, whether educated or not, after half an hour's practice, can take legible fingerprints.
3	If measurements are inaccurately taken, or accurately taken but wrongly read off or wrongly transcribed, the error cannot afterwards be discovered and remedied in the office where the cards are permanently kept, and this error will persist and defeat all chance of successful search. If the data recorded are incorrect, no amount of care can afterwards remedy the defect.	3	Finger-prints are absolute impressions taken from the body itself under conditions which eliminate error as regards transcription or recording. An effective device is adopted to guard against their being imprinted in a wrong sequence. After the "rolled" impression of each digit is taken separately, the digits are confined together in a metal guard and impressed simultaneously as "plain," impressions, thereby securing their occurrence in a correct sequence and these "plain" impressions are compared with the "rolled" impressions at the time of classification. These might be incorrectly classified but would be noticed later.
4	Recording measurements takes much time, as to ensure reliability each measurement should be taken through several times	4	The impressions of the ten digits can be taken in less than one quarter the time needed for measuring. No record of marks

and the mean result only accepted. Marks and scars are noted, and this necessitates the body being uncovered. The measurements of young persons who have not attained full physical growth alter as they approach maturity.

and scars is required, consequently the subject has not to divest himself of his clothes. The patterns of impressions and the ridges of which they are composed retain their peculiarities absolutely unchangeable throughout life.

5 A margin, greater or less, must always be allowed for errors on the part of the operator for what may be termed the "personal equation" error of operators. This makes search for duplicates particularly onerous. For instance, when a card with length of head 18.4 is received, it is necessary to assume that the operator may have gone wrong within two millimetres (a millimetre being about 1-25 of an inch) either in excess or defect and search accordingly is made between 18.6 and 18.2, but the former measure may fall under limit "long" and the latter under limit "medium" i. e. two pigeon-holes must be examined. Similar allowance has to be made in respect of all the other measurements, with the result that the process of search with a record of 30,000 cards may occupy an hour or longer.

5 No allowance for error on the part of the operator is made or needed. Working results in India show that, in 1898. 500 anthropometric references necessitated 4,623 pigeon-holes being searched, whereas 500 finger impression references in 1899 necessitated only 707 pigeon-holes being searched. Under the latter system, on an average, search was exhausted by the examination of $1\frac{1}{2}$ pigeon-holes, the extension of search beyond the one pigeon-hole indicated being made to discount any possible variation in classification; while, under the former, more than 9 pigeon-holes had to be searched. The records were approximately equal in volume.

6 Search is made according to the somewhat complicated limits and subsidiary limits contained in a figured "Key," the details of which even practised searchers could not be trusted to commit to memory. The preparation of the "search slip" takes time, more particularly when several of the measurements are near the margins which separate "long" "medium" and "short," and many pigeon-holes may be specialized for examination, and this requires close attention to ensure that there shall be no omissions.

6 No Key is required. The searcher decides whether the impression of each digit, the digits being arranged in five pairs, is a whorl (the term including Composite patterns), or not a whorl. If it is a whorl, he gives it a prescribed numeral value according as it occurs in the first, or second, or third, or fourth, or fifth pair, and the sum of such values gives a result fixing the particular pigeon-hole out of 1,024 where the card should be placed. The secondary or sub-classification is done equally rapidly and without a Key.

7 The strongest feature of anthro-
   pometry is the excellence of the
   system of primary classification
   whereby the cards are distri-
   buted, according to length and
   breadth of head, length of left
   middle finger, length of left
   forearm, and length of left foot,
   among 243 pigeon-holes.

7 By an arrangement somewhat
   similar in principle, upon the
   determination whether the pat-
   tern on each digit in turn is a
   whorl or not a whorl, finger im-
   pressions are, in primary clas-
   sification, rapidly distributed
   amongst 1,024 pigeon-holes, and
   effective means of splitting up
   accumulations by secondary
   classificaion are provided.

The committee in making the above comparison
closed their report as follows "In conclusion, we are of
opinion that the method of identification by means of
finger-prints, as worked in the system of recording
impressions and of classification used in Bengal, may be
safely adopted as being superior to the anthropometric
method—

    (1) in simplicity of working;

    (2) in the cost of apparatus;

    (3) in the facts that all skilled work is transferred
        to a central or classification office.

    (4) in the rapidity with which the process can
        be worked.

    (5) in the certainty of the results.

Upon the receipt of this report, the Governor-Gen-
eral in Council, by a resolution of June 12, 1897, directed
that the Finger-Print system of identification of Criminals
is to be adopted generally in British India.

It has since been introduced into the Presidencies of
Bombay and Madras, into the Panjab, United Provinces,
Bengal, Burmah, Central Provinces, and other parts,
over an area containing a population of close on 300
millions. The anthropometric system had been worked
in all these Provinces except Burmah, and between
150,000 and 200,000 anthropometric cards had been
collected and classified. For these, finger-print impres-
sions have now been substituted. In India the Crimi-

nal Record in 1905 must in the aggregate exceed half a million sets of impressions. In England it at present contains about 80,000 slips.

Table showing the increase in numbers of Identifications effected through the use of the Finger-Print system in countries giving returns from its introduction in 1897 to 1904

Name of Country or Province	1897	1898	1899	1900	1901	1902	1903	1904
England						503	3,642	5,155
Bengal (when first used)	174	345	569	692	1,259	1,531	1,554	1,776
United Provinces			261	750	916	1,360	1,691	1,892
Panjab					365	549	842	1,151
India { Bombay			104	287	261	459	595	800
Madras			377	474	575	663	815	813
Burmah				47	146	182	273	304
Central Provinces						62	183	224
Transvaal So. Africa							197	354
Natal " "							2,362	10,275
Total								22.744

As previously explained, the number of recognitions effected must depend upon the limitation or extension of the system. In England and India, and the Transvaal, only those persons are finger printed for criminal purposes who have been convicted of the more serious offences against property, or the person and property. In Natal, the system has been extended in the case of natives to nearly all minor offences consequently the number of recognitions is very large.

There seems no reason to doubt that the progressive success here shown will be maintained, since it is due to the greater effectiveness of the new system. Innumerable instances have come to notice during the year of recognitions effected by finger impressions which could not have been made out from the anthropometric data supplied, the original measurements recorded, and those subsequently taken, exhibiting variations so great as to

frustrate all chance of successful search. As before
explained, there must be a residuum of error attribu-
table to what may be termed the personal equation of
the measurer, however well devised the checks may be,
or however good the instruments used. The operator
may be slack and not take the measurements with suffi-
cient care, or having taken them correctly he may tran-
scribe them incorrectly. These possible defects are
inherent in the system, but do not occur when finger-
prints are taken. The subject himself impresses his
own prints, and it is immaterial whether he presses
forcibly or softly, provided that the lineations are visible.
He might make these prints in their wrong sequence, but
this error would be at once detected by the classifying
office, and as a matter of fact has often been discovered
and remedied. There are consequently under the new
system fewer possibilities of leakage, and there must
necessarily be an increase in the number of successful
cases. The views here expressed are fully borne out by
results up-to-date, which appear to indicate that many
identifiable cases may, in preceding years, have escaped
recognition by anthropometery.

PRIMARY CLASSIFICATION.

The "rolled" impressions of the digits are recorded
in their natural order of thumb, index, middle, ring,
and little finger—those of the right hand being in line
above, immediately below them the impressions of the
corresponding digits of the left hand. At the bottom
of the slip the "plain" impressions of the index, middle,
ring and little fingers of both hands are taken also. It is
essential to correct classification that the digits should
be printed in their proper sequence; and as it could hap-
pen, through inadvertence on the part of the operator,

that the impression, say, of the right index might appear
as that of the middle or ring finger, the following check
is provided.

After the "rolled" impressions have been taken, the
index, middle, ring and little fingers of each hand are
dabbed down on the paper so that the imprints of their
first phalanges are simultaneously made and they must
appear of necessity in their proper sequence.   When
slips are being classified, their "plain" prints are invari-
ably compared with the "rolled" impressions.   This
check, simple as it may appear, proves completely effec-
tive.   See Plates 1 and 2.

The impressions are then read off in the following
pairs; right thumb and right index; right middle and
right ring; right little finger and left thumb; left index
and left middle; left ring and left little finger.

In rounded numbers about 5 per cent of impressions
are arches, 60 per cent. Loops, and 35 per cent. Whorls
and Composites, the proportion varying in the several
digits, but the relative preponderance of Loops and
Whorls being maintained.

This fact has been taken into account in devising a
system of primary classification.

The proportion of Arches and Composites being rela-
tively small, Arches in primary classification are includ-
ed under Loops, and Composites under Whorls.   In
primary classification therefore an impression must be
either a Loop (Arches being included) or a Whorl
(Composites included).   Taking the first pair, the
arrangements possible among them are; right thumb
a Loop and right index a Loop; right thumb a Loop and
right index a Whorl; right thumb a Whorl and right index
a Loop; right thumb a Whorl, right index also being a
Whorl.

The above exhausts all possible arrangements, and
may be thus set out—the numerator letters referring

to the thumb or first of the pair, the denominators to the index or second of the pair; $\frac{L}{L}$; $\frac{L}{W}$; $\frac{W}{L}$; $\frac{W}{W}$.

We have the same numbers of combinations for the second pair; and, as each of these can be combined with each arrangement of the thumb and index, the total combinations of the two pairs taken together is 16. The third pair has similarly four arrangements, which, taken with those of the preceding two pairs, raises the number of combinations to 64; adding the fourth pair this number rises to 256, and with the fifth pair to 1,024.

The number 1,024 is the square of 32, so two cabinets containing 16 drawers each and each drawer containing 32 primary numbers would provide for filing all combinations of Loops and Whorls of the ten digits taken in pairs.

In practice it is found more convenient to take impressions, not on cards, but on stout paper foolscap size, termed "slips," The frontispiece show the cabinets in actual use in the office of the agent for the Mass. State Bureau of Criminal identification.

ARITHMETICAL RULE FOR DETERMINING PRIMARY CLASSIFICATION.

The digits, are taken in pairs, the first of the pair being shown as numerator and the second as denominator, the formula thus obtained being of the following kind: $\frac{L}{W}$; $\frac{W}{L}$; $\frac{L}{L}$; $\frac{W}{W}$; $\frac{L}{W}$.

When a whorl occurs in the first pair it counts 16, in the second pair it counts 8, in the third 4, in the fourth 2, and in the fifth 1; no numerical value is given to a Loop.   The above formula can be expressed thus: $\frac{0}{16}$; $\frac{8}{0}$; $\frac{0}{0}$; $\frac{2}{2}$; $\frac{0}{1}$.   Numerators are added together, also denominators and the totals exhibited as a new fraction $\frac{10}{19}$ To both numerator and denominator one

(1) is added, making $\frac{1}{2}\frac{1}{0}$ and this fraction inverted gives the primary class number $\frac{2}{1}\frac{0}{1}$ which represents that the impression slip will be found in the drawer 20 and denominator 11 in filing cabinet.

Given the primary classification number, it obviously is easy to work backwards and determine the type of each digit. Taking the primary classification number $\frac{2}{1}\frac{0}{1}$ it is seen that 20 falls short of 32 by 12, which is equivalent to $8 + 4$; we know therefore that whorls are wanting in the second and third pairs and in the denominator, for, as above explained, $\frac{2}{1}\frac{0}{1}$ is the inversion of $\frac{1}{2}\frac{1}{0}$ similarly 11 falls short of 32 by 21, which is equivalent to $16 + 4 + 1$, and we know therefore that Whorls are wanting in the first, third, and fifth pairs (numerator). Where Whorls are wanting, Loops must take their place, and so we get back at once to the formula $\frac{L}{W}; \frac{W}{L}; \frac{L}{L}; \frac{W}{W}; \frac{L}{W}$. Classification numbers run not 1 to 1,024 consecutively, but from 1 to 32; 2 to 32; 3 to 32 and so on to 32 to 32.

In the State of Mass. Bureau of Criminal Identification in the State House, Boston, the Mass. Agent has installed two cabinets, each cabinet containing 16 drawers and each drawer containing 32 primary numbers, which are used by him for filing finger-prints.

SECONDARY OR SUBCLASSIFICATION.

Owing to the occurrence under certain primary classification numbers of large accumulations, secondary or subclassification is required to break them up into groups of convenient size. Similar trouble is experienced with measurements under the anthropometric system, the tendency where length of head or width of head or length of forearm is "long" or is "short" for the other measurements to be "long" or to be "short"

being very noticeable, and numerous other such complications arise which do not however trammel the finger-print system.

As has been previously stated, the fingers are impressed in their natural sequence, the thumb first, then the index, middle, ring and little finger, those of the right hands being above and immediately below each of its digits, the corresponding digit of the left hand. The index finger of each hand is taken as a *fulcrum*, the mark specializing it being the capital letter of its symbol, the mark specializing the thumb being the small letter of its symbol placed to the left of the *fulcrum*, the marks specializing the remaining fingers being the small letters of their symbols to the right of the *fulcrum*. Arches, Tented Arches, and *radial* Loops being of relatively infrequent occurrence are utilized in subdividing, and their presence is invariably noted in the subclassification formula.

This formula is in the form of numerator and denominator, the numerator referring to the right, the denominator to the left hand. Formula $\frac{1}{1}$ $\frac{a}{r}\frac{A}{R}\frac{r}{a}$ indicates that the slip containing the impressions will be found under classification number $\frac{1}{1}$, and will there be found included in the collection specialized by having an Arch in the right thumb, an Arch in the right index, and a *radial* Loop in one of the remaining digits of the right hand, while the left thumb and index are *radial* Loops, one of the other digits of this hand being an Arch.

SUBCLASSES FORMED BY ARCHES AND RADIAL LOOPS.

Classification number $\frac{1}{1}$ contains the slips, all the impressions of which are Loops as distinguished from Whorls (Loops including Arches, Tented Arches, *radial* and *ulnar* Loops); and we have now to consider the

methods for dividing its accumulation into subclasses and groups.

Arches, *radial* and *ulnar* Loops may occur on one or both index fingers in nine combinations, as thus exhibited, and when they occur they provide for the formation of nine subclasses. The letters—

	A	R	U
A			
R			
U			

arranged horizontally refer to the right, those vertically to the left index. Under subclass $\frac{A}{A}$ will be found accumulated the slips with an Arch in both index fingers; under $\frac{A}{R}$, those with an Arch in the right and *radial* Loop in the left index; under $\frac{A}{U}$, those with an Arch in the right and *ulnar* Loop in the left index. Similarly there are subclasses: $\frac{R}{A}$; $\frac{R}{R}$; $\frac{R}{U}$; $\frac{U}{A}$; $\frac{U}{R}$; $\frac{U}{U}$. These nine subclasses representing the nine combinations.

In subclass $\frac{A}{A}$ as Arches may occur in one, two, three, four, or five fingers, the number of groups created by utilizing them may be thus exhibited:

1	2	3	4	5
-	A	-	-	-
-	A	a	-	-
-	A	-	a	-
-	A	-	-	a
-	A	a	a	-
-	A	a	-	a
-	A	-	a	a
-	A	a	a	a

1	2	3	4	5
a	A	-	-	-
a	A	a	-	-
a	A	-	a	-
a	A	-	-	a
a	A	a	a	-
a	A	a	-	a
a	A	-	a	a
a	A	a	a	a

Where 1 denotes the position of the thumb, 2 of the index, 3 of the middle, 4 of the ring, and 5 of the little finger. There will be a like number of groups for the fingers of the other hand, and, as both hands are utilized

in splitting up subclasses, the total number that may be created by this device is 16x16—256.

An equal number of groups will be created by the occurrence of *radial* Loops in both hands, or of *radial* Loops in one and Arches in the other.   In subclasses $\frac{A}{A}$; $\frac{A}{R}$; $\frac{R}{A}$; $\frac{R}{R}$, 256 such groups can be made

This, however, is a number in excess of requirements, and in practice a smaller number are employed, formed upon deciding whether there are one, two, or three Arches to the right of the index or fulcrum.   These groups are—A; aA; Aa; aAa; A2a; aA2a; A3a; aA3a; they are arranged amongst themselves in the order here given.

This substitutes 64 for the possible 256 groups. When Tented Arches take the place of Arches, they are placed below the slips containing Arches to the same number.   Thus aAt would be disposed immediately below the aAa group; aAat below the aA2a group. When *radial* Loops occur they are disposed immediately below the groups containing the same number of Arches and Tented Arches; aAr would be placed next below groups aAt and aAar below aAat.

In subclasses $\frac{A}{U}$; $\frac{R}{U}$ the numerators provide 16 combinations and the denominators a number of combinations formed by ridge *counting*, the details of which are explained when subclass $\frac{U}{U}$ is being dealt with.

In subclasses $\frac{U}{A}$; $\frac{U}{R}$, there are 16 possible combinations in the denominator and in the numerator, combinations from ridge *counting*.

In subclass $\frac{U}{U}$, although both index fingers are *ulnar* Loops, Arches or *radials* may occur in the remaining digits, and groups can be found accordingly.   This subclass into two, the first denoted as $\frac{U}{U}$ (lettered), of which instances are $^a\frac{U}{U}$; $_a\frac{U}{U}$; $\frac{U}{U}^a$, etc., the term lettered referring to the appearance on either side of numerator or denominator of the letters a, r, or t.   The other subclass is $\frac{U}{U}$ unlettered.

The system adopted by the Mass. Agent for filing finger prints containing Arches in the primary class $\frac{1}{1}$ is so complete, so simple in its operation and so perfect in its results when making a search, that its merits need only be mentioned to be appreciated and adopted in preference to the intricate system of filing Arches adopted by foreign countries. Treating finger print impressions in class $\frac{1}{1}$ for purposes of filing only, as though the Arches on the different digits were whorls, brings all finger prints which contain Arches on the same digits together when filed. This method of filing arches can be applied to any primary number containing a great number of arches.

SUBDIVISION BY RIDGE COUNTING.

These methods of selection for separate subclasses leave the residuum under subclass $\frac{U}{U}$ in which all impressions are *u'nar* Loops.

The proportion of slips containing such impressions lies between 4 and 5 per cent. of the total record, and necessarily in a large record represents a considerable number of slips, which are, however, reduced to convenient sized groups. The number of ridges which intervene between the "inner" and "outer terminus" can, with the aid of a reading glass and a pointer, be *counted* correctly. A little practice gives the needed accuracy. Trials made with many thousand impressions yield the following results.

⋅ In the index finger the number of impressions which have from one to nine ridges between the "inner" and "outer terminus" (both these fixed points being excluded from count) equals the number of impressions ten or more than ten ridges. In the middle finger the number with from one to ten ridges equals the number with eleven or more. Calling the lower limit I and the

higher limit O, taking both index and middle finger of each hand, the number of arrangements possible may be thus set out, the "letters horizontally disposed referring to the right index and middle, those vertically to the index and middle of the left hand.

This represents 16 groups, viz.: $\frac{II}{II}$; $\frac{IO}{II}$; $\frac{OI}{II}$; $\frac{OO}{II}$; $\frac{II}{IO}$; $\frac{IO}{IO}$; $\frac{OI}{IO}$; $\frac{OO}{IO}$; $\frac{II}{OI}$; $\frac{IO}{OI}$; $\frac{OI}{OI}$; $\frac{OO}{OI}$; $\frac{II}{OO}$; $\frac{IO}{OO}$; $\frac{OI}{OO}$; $\frac{OO}{OO}$; which amongst themselves are arranged in the above order. The advantage of this method is that in most instances it is possible to decide on view whether the ridge *counts* fall within the lower or higher limit. The eye can decide at a glance that an impression with 15 ridges falls within the O limit, one with 5 within the I limit, and this means much saving of time in subclassifying. It is only when the ridge *count* approaches the limit between I and O that greater accuracy is needed. In each of these 16 groups the slips are arranged amongst themselves according to the *count* of ridges in the right little finger. This represents a further splitting up, the subgroups thereby created being so small as to render search comparatively easy and rapid. The full formula for one of these slips would be of the following kind $\frac{1}{1}$ $\frac{U}{U}$ ($\frac{IO}{OI}$) 6. The searcher would proceed to the accumulation of slips marked $\frac{1}{1}$, select the file $\frac{U}{U}$, containing subclass $\frac{U}{U}$, and search in subgroups 6 of group ($\frac{IO}{OI}$) of this file.

This application of the principle of *counting* the ridges in four fingers is not confined to subclass $\frac{U}{U}$, but is employed in the other subclasses of $\frac{I}{I}$, and may be employed in classes $\frac{5}{1}$, $\frac{9}{1}$, $\frac{1}{2}$, $\frac{5}{2}$, $\frac{9}{2}$, $\frac{10}{2}$, $\frac{13}{2}$, $\frac{9}{6}$, $\frac{10}{6}$, $\frac{1}{17}$, $\frac{5}{17}$, $\frac{9}{17}$, $\frac{13}{17}$, $\frac{1}{18}$, $\frac{5}{18}$, $\frac{9}{18}$, $\frac{13}{18}$, $\frac{14}{18}$, $\frac{9}{22}$, $\frac{10}{22}$, $\frac{13}{22}$, $\frac{14}{22}$ to break their subclasses into groups when their totals are sufficiently large to require such minute subdivision.

SUBDIVISION BY RIDGE TRACING.

There are marked accumulations under the classification numbers, where are collected together the slips containing impressions all or nearly all of which are whorls (including composites), and subclassification here is needed. Ridge *tracing* has been explained.

As specialized by the course of the lower limb of the ridge forming the left delta, a whorl may be I or M or O. The index and middle finger of the right hand being taken, the former may be I or M or O, and the middle finger may also be I or M or O, so the combinations of the two fingers taken together will be nine, and, when these are taken with the similar arrangements for the corresponding two fingers of the left hand, the total number of combinations rises to eighty-one, each of which represents a separate determinable group. These may be shown in the following diagram, where the letters set out horizontally refer to the right hand, the first of each pair specializing the index and the second the middle finger, while the letters set out vertically refer to the left hands:

		II (1)	IM (2)	IO (3)	MI (4)	MM (5)	MO (6)	OI (7)	OM (8)	OO (9)
II	(1)									
IM	(2)									
IO	(3)		•							
MI	(4)									
MM	(5)									
MO	(6)									
OI	(7)									
OM	(8)									
OO	(9)									

The full formula for a slip in which all or nearly all the impressions are whorls would be of the following kind: $\frac{3}{3}\,\frac{2}{2}\,\frac{\text{I}}{\text{M}}\,\frac{\text{O}}{\text{I}}$ or $\frac{3}{3}\,\frac{1}{2}\,\frac{\text{M}}{\text{I}}\,\frac{\text{M}}{\text{I}}$, where the figures represent the primary and the lettering the subclassification. To further simplify this, the lettering, as can be seen in the diagram, may be more concisely expressed in figures, and the above formula would then become $\frac{3}{3}\,\frac{2}{2}$ ($\frac{3}{4}$) or $\frac{3}{3}\,\frac{1}{2}$ ($\frac{5}{1}$), where the figures in brackets denote the groups formed under classification numbers $\frac{3}{3}\,\frac{2}{2}$ and $\frac{3}{3}\,\frac{1}{2}$.

Amongst themselves these groups are disposed as follows: ($\frac{1}{1}$), ($\frac{2}{1}$); (^{3} to ^{9}), and then ($\frac{1}{2}$), ($\frac{2}{2}$), ($\frac{3}{2}$), ($\frac{4}{2}$), and so on.

Ridge *tracing* in all four fingers is used for splitting up into groups the accumulations under $\frac{2}{2}\,\frac{7}{8}$; $\frac{3}{2}\,\frac{1}{8}$; $\frac{3}{2}\,\frac{2}{8}$; $\frac{2}{3}\,\frac{8}{2}$; $\frac{3}{3}\,\frac{1}{2}$; $\frac{3}{3}\,\frac{2}{2}$; and is applicable to some others when the number of their slips is sufficiently large to necessitate further subdividing.

In Central Pockets, Lateral Pockets, Twinned Loops, most Accidentals, and in a fair proportion of whorls, the differentiation into I, M, O can be made at a glance. It is only when the whorl has symmetrically disposed deltas, that is deltas which appear to be at almost the same distance from its Core, that careful *tracing* is needed. The labour entailed by noting whorls as I, M, or O consequently is much less than might seem probable, and after a little practice will be found to have no special difficulties. Cases will occur where, owing to the imperfections of the print, it is not possible to decide with certainty, and in such instances double search is made. Thus, if it is doubtful whether a particular Whorl is I or M, search is made on the assumption first that it is I, and if this fails, search is made on the assumption that it is M.

CLASSIFICATION OF DAMAGED OR MISSING FINGERS.

It is essential that the slips accepted for permanent record shall contain the best impressions procurable. If the prints are clear and the ridges sharply defined, the task of classifying presents no difficulties. On receipt, the impressions are scrutinized, and if amongst them blurred or imperfect prints are discovered, the slip is returned and a more carefully prepared duplicate called for. As the impressions of convicts are taken within a few days after sentence is passed, this duplicate can be obtained at any time during their detention in jail. Skin disease and injuries have the effect of blurring or effacing the ridges.

By allowing time to elapse, the disease may lessen or the effects of the injuries disappear, and the obliterated ridges will grow again and the prints from them regain their normal appearance and sharpness of outline. It should therefore be the rule in all Central offices not to admit for permanent record, slips containing imperfect impressions, until it is ascertained that better are not procurable. When a digit is deformed or missing, no imprint of it can be taken, and the space in the slip assigned to it must remain blank. When one digit is deformed or missing, classification is made according to the correspondenting digit of the other hand. If the same digit of both hands is missing, the impressions are held to be whorls, and classification made accordingly. The absence of even more than two digits does not prevent classifications.

The methods adopted for breaking up the largest accumulations, viz., those in which all or nearly all the impressions are Loops or are Whorls, having been understood, little difficulty will be experienced with the smaller

accumulations. They are dealt with on similar lines, the presence of Arches or Radials being utilized, and ridge *counting* or ridge *tracing*, or both, being employed.

The Primary Classification number having been worked out and recorded, the slip is again inspected. An Arch or Radial in any of the digits at once arrests attention, and its presence shapes subclassification.

In Plate 2, if there were an Arch in the right thumb, the formula would be changed to $\frac{1}{2}3$; $^a\frac{U}{U}$; if in the right middle, to $\frac{1}{1}\frac{3}{8}$; $\frac{U}{U}\overset{a}{.}$; if in the left middle, to $\frac{1}{1}\frac{3}{8}$; $\frac{U}{U}A$. With a *radial* Loop in the right thumb, it would be $\frac{1}{2}3$ $^r\frac{U}{U}$; in the right middle or little finger, $\frac{1}{1}\frac{3}{8}$; $\frac{U}{U}r$; in the left middle or little finger $\frac{1}{1}\frac{3}{8}$; $\frac{U}{U}r$;—all these representing groups so small as to need no further subdividing.

With an Arch in both indexes, it would be $\frac{1}{1}\frac{3}{8}$; $\frac{A}{A}$; an Arch in one index, $\frac{1}{1}\frac{3}{8}$; $\frac{A}{U}$ or $\frac{1}{1}\frac{3}{8}$ $\frac{U}{A}$; or $\frac{1}{1}\frac{3}{8}$ $\frac{A}{R}$; and with Arches or Radials in the other digits also a large number of groups, as has already been explained at length, could be found. Having disposed of the slips in which Arches and Radials occur, we now deal with the remainder; and it must be understood that the subdivision here described is required only when, owing to the record being very extensive, accumulations become relatively large. If the index and middle of the right hand are Loops, their ridges are *counted*, and the combined result exhibited as numerator of the subclassification fraction (in brackets); if index and middle of left hand are whorls, their ridges are *traced*, and their combined result exhibited as denominator.

In $\frac{1}{1}3$ $\frac{U}{U}$ $\left(\frac{I\ O}{I\ I}\right)$; $\frac{5}{2}\frac{R}{U}$ $\left(\frac{I\ I}{O\ O}\right)$; $\frac{9}{6}$ $\frac{U}{U}$ $\left(\frac{O\ I}{O\ O}\right)$; $\frac{1}{2}\frac{3}{2}$ $\frac{R}{R}$ $\left(\frac{I\ O}{I\ I}\right)$ the index and middle of both hands being Loops, the numerator and denominator exhibit the combined result of ridge *counting* in the index and middle of right and left hand respectively.

It will be noticed that, when a *radial* occurs in the

index, alone, the further subdivision is carried out precisely as if it were an *ulnar* Loop, but the group so formed will be found not under subclass $\frac{U}{U}$ but under subclass $\frac{U;\ R;\ R}{R;\ R;\ U}$. In $\frac{1\ 1}{4}$ $\left(\frac{I\ O}{M\ M}\right)$; $\frac{1\ 5}{2\ 0}$ $\left(\frac{I\ I}{O\ M}\right)$; $\frac{1\ 6}{2\ 4}$ $\left(\frac{O\ I}{I\ M}\right)$ the numerator represents the combined result of ridge *counting*, the denominator of ridge *tracing*.

In $\frac{2\ 7}{1\ 2}$ $\left(\frac{M\ O}{O\ M}\right)$; $\frac{3\ 1}{1\ 2}$ $\left(\frac{I\ M}{M\ M}\right)$; $\frac{2\ 7}{1\ 6}$ $\left(\frac{I\ O}{M\ I}\right)$ $\frac{2\ 8}{1\ 6}$ $\left(\frac{M\ I}{O\ O}\right)$ both numerator and denominator exhibit the combined result of ridge *tracing*. In $\frac{1}{9}7$ $\left(\frac{M\ O}{I\ I}\right)$; $\frac{2\ 5}{3\ 0}$ $\left(\frac{M\ M}{I\ I}\right)$; $\frac{2\ 9}{3\ 0}$ $\left(\frac{O\ M}{O\ I}\right)$; $\frac{3\ 0}{3\ 0}$ $\left(\frac{O\ O}{I\ I}\right)$ the subclassification numerator represents the combined result of ridge *tracing*, the denominator the combined result of ridge *counting*.

When the index and middle of the same hand are of different types, i. e. one a Loop and the other a Whorl, the index only is dealt with, its ridge *counting* or ridge *tracing* result alone being exhibited. This applies to both hands. In $\frac{9}{9}$ $\left(\frac{I}{I\ I}\right)$; $\frac{9}{0}$ $\left(\frac{O}{I\ O}\right)$; $\frac{9}{2\ 6}$ $\left(\frac{I}{O\ I}\right)$; $\frac{1\ 3}{2\ 6}$ $\left(\frac{O}{O\ I}\right)$ the right index is a Loop, right middle a Whorl, both left index and middle being Loops; the numerator shows the result of ridge *counting* in the right index only, the denominator the combined result of ridge *counting* in left index and middle.

In $\frac{2}{2}8$ $\left(\frac{M}{I}\right)$; $\frac{3\ 1}{1\ 8}$ $\left(\frac{M}{O}\right)$; $\frac{3\ 2}{2\ 2}$ $\left(\frac{I}{O}\right)$; $\frac{3\ 2}{2\ 2}$ $\left(\frac{O}{I}\right)$ the right index is a Whorl, the right middle a Loop, the left index a Loop, the left middle a Whorl; the numerator gives the result of ridge *racing* in the right index only, the denominator the result of ridge *counting* in the left index only.

The largest accumulations are found under Primary Classification numbers $\frac{1}{1}$; $\frac{5}{1}$; $\frac{9}{1}$; $\frac{1}{2}$; $\frac{9}{2}$; $\frac{1}{1\ 7}$; $\frac{5}{1\ 7}$; $\frac{1\ 3}{1\ 7}$; $\frac{9}{1\ 8}$; $\frac{1\ 3}{1\ 8}$; $\frac{2\ 8}{3\ 2}$; $\frac{3\ 1}{3\ 2}$; $\frac{3\ 2}{3\ 2}$. The first ten are reduced to groups by utilizing the presence of Arches or Radials, or by ridge *coun ing*, the index and middle of both hands in these ten accumulations being Loops. The last three are reduced by ridge *tracing*, the index and middle of both hands being whorls.

The complete system of classification and subclassification, as explained in preceding pages, is exhibited in plate 5. As an additional check against any clerical error which might occur in writing the name of the person whose finger prints are taken on the form I or II through inadvertence, when several persons are having their finger impressions taken, the precaution of having the print of the right index finger made on the back of the form immediately after the signature is written is prescribed. By this means a mistake can at once be detected by comparing the impression with the print on the other side, which is folded over for the purpose. The signature and the finger impression should invariably be taken on the back of each form at once.

APPLICATION OF SYSTEM TO POLICE WORKING.

The manner in which the system works in the Police Department may be described.

A man charged with housebreaking and theft is convicted under the name of John Smith, sentenced to a term of imprisonment and sent to jail, where his finger-prints, together with the finger-prints of other prisoners received, are taken by a prison warden. On the back of each slip is recorded the prisoner's name with dates and full particulars of the case, and the slip thus filled up is forwarded to the Central office. On receipt there, they are classified and filed in their respective collections and groups. The data for classifying are so few and so simple that any person can carry them in his memory—method and accuracy only being needed The staff at the Central office, being picked out as men possessing aptitude for the work, by prac- . tice soon become experts in it.

After the lapse of a year or two, the Central office

receives from police or keeper of a jail a slip containing the finger prints of a man on trial for theft, who has given the name of William Jones, and other information concerning himself, which the inquiries locally made show to be false.

METHOD OF SEARCH.

On receipt of the slip the officer at the Central Bureau makes the necessary Classification which is as follows and then proceeds to search. The type in all the impressions is unmistakable, so there can be no doubt as to the correctness of the Primary Classification number $\frac{1}{1} \frac{Aa}{Aa}$ 5, filing number $\frac{19}{11}$. (See plate 1.) The index and middle of the two hands is also obviously correct —but there may be divergence of opinion as to there being exactly 5 *counts* in the right little finger. To eliminate the possibility of error arising from this, he decides to search through the subgroups, which have from 2 to 5 *counts* in the right little finger. Being confident of the correctness of his own counting, he would first search the subgroup with 3 to 5 *counts* in the little finger, then the subgroups with 6 to 7 ridge *counts*. If the slip he is looking for is in the Criminal Record, he knows it must be among subgroups $\frac{1}{1} \frac{Aa}{Aa}$ filing number $\frac{19}{11}$ which file he picks out, and he concerns himself no further with ridge *counts*, but concentrates attention upon the salient features of the slip. The right thumb is a Ulnar Loop with 13 ridge *counts*, the left thumb an Ulnar Loop. He turns the slips of subgroups $\frac{Aa}{Aa}$ filing number $\frac{19}{11}$ over rapidly, much in the same way as a pile of bank notes are looked through, and delays only when he comes to a slip the right thumb impression of which is an Ulnar Loop, and his eye then glances at the left thumb. If it is not an Ulnar Loop,

he passes on to the next slip, and finally stops at one which has the right thumb an Ulnar Loop, the left thumb an Ulnar Loop also, and the two ring fingers Ulnar Loops. He then compares the ridge *characteristics* of one or two impressions on the slip in his hand with the corresponding impressions of the slip in the Record, and if they agree he knows that his search has been successful.

The Central office then informs the requisitioning police that the so called William Jones was on a specified date, convicted under the name of John Smith, of housebreaking with theft, and gives all the information concerning him recorded on the back of their slip, which is sufficient to enable the local police to prove, in the manner prescribed by law, the previous criminality of the soi-disant Wm. Jones. $\frac{1}{1}\frac{Aa}{Aa}$ is not a large collection, exhaustive search for a duplicate in it, even when the Record consists of 100,000 slips, can be completed in a few minutes' time.

A practiced person carries photographed on his eye the salient features of the slip he is looking for, and can search for it as rapidly as his hand is able to turn over the Record slips.

GRADATIONAL CASES.

It will be noticed that the possibility of search extending beyond subgroups $\frac{1}{1}\frac{aAa}{Aa}$ has been discussed, and this leads to the consideration of what may be termed gradational or transitional cases. Doubt may arise as to the type of an impression, and consequently as to its correct Primary Classification number. In plate I it might be contended that the left index is not an Arch, the details of the pattern placing it on the border

line which separates Loops from Arches, and that some persons might classify it as an Arch, others as a loop with one ridge count.   If the left index is a loop the Primary Classification would not be altered, but the filing number instead of being $\frac{19}{11}$ would be found among the collection in filing number $\frac{19}{9}$. To eliminate any uncertainty arising from the possibility of varying classification, search is made under the accumulations of both numbers, and in the groups here specialized, viz.: Plate 1 $\frac{1}{1}$ $\frac{Aa}{Aa}$ 5, filing number $\frac{19}{11}$, and under $\frac{1}{1}$ $\frac{Aa}{Ua}$ 5, filing number $\frac{19}{9}$ The groups indicated contain few slips in both filing numbers, $\frac{19}{11}$ and $\frac{19}{9}$, and so this double search, even when the Record is very extensive, occupies little time.

Gradational cases, whether known as hybrids, sub-species, varieties, or under other names, are common to all sciences.   A definition can only make known a finite number of the characteristics of an object selected as the type, and it is always possible that objects agreeing in the assigned characteristics may differ in others, and by gradation, insensibly varying from each other, depart more and more from the defined type.   When it is realized that even at the present time no vigorous boundary can be laid down between the vegetable and animal kingdoms, it will not appear anomalous that gradational forms should occur in any system of finger-print classification however carefully worked out. That their occasional presence in no degree hampers the application of the system to practical working, will be manifest to those who have the opportunity of conducting searches under it.

PHOTOGRAPHING AND ENLARGING PHOTOGRA-GRAPHS OF FINGER-PRINTS.

The photographing of finger marks left by criminals on articles, such as plated goods, window panes, drinking glasses, painted wood, bottles, cash boxes, candles, etc., have in many instances, from time to time, successfully supplied the clue which has led to the apprehension of the thief or thieves.

Situated on the ridges of the finger bulbs are the numerous mouths of the ducts which conduct to the surface the perspiration from the sweat glands which lie below the true skin; and through these there is a continuous flow, although, generally, imperceptible to the naked eye. In consequence of this moisture, when a finger comes in contact with a cold dry smooth surface the pattern of the ridges is left more or less distinct on the article touched.

Finger marks on light painted wood-work are easily photographed as the finger marks appear in a more or less dark colour on a light ground. In such cases the photographer should proceed in the same manner as he would for black printed matter, care being taken in lighting the subject to get rid of the shadows caused by the grain of the wood. Finger marks on plated goods placed squarely with the camera in a strong side light will appear light on a dark ground. These marks being the reverse in colour to those on wood-work, where the patterns of the ridge lines show black on a white ground, it is necessary to treat them in the following manner:— Focus sharply. Should, however, the mark be too faint to be clearly seen on the focussing screen, a piece of printed paper can be placed around the mark to focus by, but this should be removed before exposing the plate, otherwise halation will set in and obscure some of

the lines in the finger mark. The plate should be re-
versed when placed in the slide, that is to say, the glass
side should be nearer the lens, otherwise the photo-
graphs will show left for right, e. g., "B   will appear
as "ᗺ."

If the printing be done from this plate the ridge
lines will appear white on a dark ground, which is the
reverse of what is required, therefore a transparency
must be made from the plate or negative, and the print-
ing be done from the transparency, which will print the
pattern of the ridge lines black on a white ground.

Finger marks on glass are to be treated in the same
manner as marks on plated goods. A piece of dead
black paper should, however, be pasted on the glass
behind the finger mark. It has often been found bene-
ficial to distribute a little of the powder which is known
to Chemists as "gray powder" (mercury and chalk),
over the finger mark and then brush off gently with a
camel-hair brush   This brings out the print more
clearly.

If it is suspected that there may be latent finger
marks on glass, wood, or metal, the   substance
should be sprinkled over with a little "gray" powder
and this subsequently lightly brushed off with a camel-
hair brush. Should however the wood be white in
colour, graphite may be used instead of the "gray '
powder. The experiment may be made of impressing
the fingers on a piece of smooth dark wood, glass, or
metal, afterwards sprinkling a little "gray" powder
over the place touched by the fingers, and brushing off
carefully with a camel-hair brush. To photograph
the marks that will show themselves, proceed as for
plated goods. At times burglars leave behind them
pieces of candle which they have handled, and on which
there are good imprints of some of their fingers. In
those instances the ridges of the fingers create furrows

in the candle and should be treated as follows:—Smear a small drop of printers black ink over the mark, and wipe off carefully with tufts of cotton wool until the ink is cleared away with the exception of that in the furrows, then photograph as for printed matter.

When finger-prints are required for production in Courts of Justice, they are first enlarged 5 diameters direct with an enlarging camera. The negatives are afterward placed in an electric light enlarging lantern, with which it is possible to obtain a photographic enlargement of a finger-print 36 inches square, such a photograph being as large as ever likely to be required.

PLATES.

It is advisab'e to use slow plates as excessive contrast is the desired end.

EXPOSURE.

It is impossible to give reliable data as to exposure but in cases where the finger marks are faint, it will be necessary to give six or even eight times the exposure required for black and white prints.

DEVELOPER.

The following is an excellent developer for finger-print work:—

A		B	
Hydrokinone	120 gns.	Carbonate Potash	20 oz.
Sulphide Soda	2 oz.	Water	20 oz.
Water	20 oz.		

For use take equal parts of "A" and "B."
All plates should be intensified before being printed from.

It is useless to attempt to photograph a finger mark unless the pattern of the ridge lines is distinctly visible.

APPENDIX

A COMMITTEE UNDER INSTRUCTIONS FROM THE GOVERNOR OF INDIA TO EXAMINE INTO THE SYSTEM OF IDENTIFICATION BY FINGER IMPRESSIONS, MAKES THE FOLLOWING REPORT:—

(a) Skilled persons are required to take the measurements and they must have sufficient education to enable them to read the instruments and to use the decimal notation. This is more particularly a serious objection in India, where warders and policemen are frequently far from well-educated men.

(b) Carefully made and delicate instruments are necessary to take the measurements with sufficient accuracy.

(c) The number of measurements to be taken is considerable, viz.: 3 for the length of head, 3 for the width of head, 3 for length of left forearm, 3 for length of left foot, 3 for length of left little finger, and 3 for height—or 18 in all; the mean of each group of 3 is taken as the final measurement. In addition to these, marks and scars are searched for and so the actual anthropometric record of one person occupies the measurer between half an hour and one hour.

(d) Owing to the liability to error in measuring or in recording the measurements, notwithstanding that the instruments used, i.e. calipers and sliding bars, have been rendered automatic in their working, and in the former case, self-regis-

tering also, it has been found desirable to allow
for a possible variation of 2 millimetres in excess
and in defect of the measurements.   This nec-
essitates, in some cases, search being made in
ten or even twelve different pigeon-holes for
the duplicate of a case which is being tested, to
ensure its not being passed over.   The average
time of search, therefore, under this system
exceeds one hour.

As an instance of how inaccuracies will creep in, the
last card, of which the original had just been discovered,
showed two errors or variations in measurements, one
being as much as $3\frac{1}{2}$ millimetres.

After having seen the anthropometric system and
having noted its defects, the system of finger impression
was carefully examined. The first thing that struck us was
the facility with which the impressions were made, and
the clearness of the impressions themselves; every little
detail being, as a rule, sharply defined and easily seen
with the help of an ordinary magnifying glass.   The
method of taking them is simplicity itself; all the
materials required are, a flat piece of tin, a bottle of
ordinary printer's ink, and a small rubber roller to
spread the ink on the tin.   The finger is rolled carefully,
without rubbing, on the inked tin, and then on to
paper: to take impressions of all the ten digits occupies
only five minutes or less, and in this short time an
absolutely accurate record, without any possibility of
accidental error, is obtained, without skilled labour
and without instruments.

The method of classification devised by Mr. Henry
was then explained to us.   The first classification divides
all the different kinds of impressions into two classes
only, which can be recognized at a glance; by taking the
combinations of these two classes, as exhibited in the
ten different digits taken in pairs, all descriptive cards

can be divided into 1024 classes, and to each class is allotted a separate pigeon-hole. By means of the Key, a copy of which is attached, any one pigeon-hole can be at once found with the greatest ease, and certainly even by a person who has never seen the system before. We were both enabled to do this at once without any difficulty. Having thus located the card in one particular pigeon-hole, a further classification is necessary to assist in the search through all the different cards in that pigeon-hole; this further classification depends on the details in the impressions, which it is unnecessary to enter into here, but it is so simple that we were both able to find the originals of two of the most intricate cards that could be produced, with ease and certainty. The men whose duty it is to look up the originals, in no case took more than five minutes to produce the original, the duplicate of which we had handed to them out of a file of some six hundred records, and the originals of which were part of a file of finger-print cards exceeding eight thousand in number. One case which was selected as being apparently an especially difficult one, as it was very indistinct, was found in two minutes only. The principles of the subclassification are such that should minute distribution be needed in consequence of any great accumulation in any one pigeon-hole, it can easily be made by extending the same principles. The system of search is therefore much more rapid and more certain than that for the anthropometric data.

The greatest sceptic would be at once convinced of identity on being shown the original and duplicate impressions. The exact repetition of most minute details is quite astonishing. There is no possible margin of error, and there are no doubtful cases.

Thus the three main conditions laid down by the Committee appointed by the Secretary of State to inquire into the best means available for identifying habitual criminals are fully satisfied, viz.—

(1) The descriptions, measurements or marks, which are the basis of the system, must be such as can be taken readily and with sufficient accuracy by prisons warders or police officers of ordinary intelligence.

(2) The classification of the description must be such that, on the arrest of an old offender who gives a false name, his record may be found readily and with certainty.

(3) When the case has been found among the classified descriptions, it is desirable that convincing evidence of identity should be afforded.

In the same report it is acknowledged that Mr. Galton's finger-print method completely met the first and third conditions, but they disapproved of his method of classification. Mr. Henry's classification and subclassification has, we consider, effectually got over the objections raised by them, for, out of eight thousand cards, no subclass contained more than from ten to twenty originals, and the system is capable of almost endless amplification, if necessary.

In conclusion, therefore, we are of opinion that the method of identification of habitual criminals by means of finger-prints as worked on the system of recording impressions, and of classification devised by Mr. Henry, may be safely adopted as being superior to the anthropometric method, (1) in simplicity of working, (2) in the cost of apparatus, (3) in the fact that all the skilled work required is transferred to the central or classification bureau, (4) in the rapidity with which the process can be worked, and (5) in the certainty of the results.

C. STRAHAN, R. E., *Major-General,*
Surveyor-General of India. ·
ALEX. PEDLER, F. R. S.,
Principal, Presidency College,
The 31st March, 1897.   *Calcutta.*

PLATE 5

SYNOPSIS OF CLASSIFIED COLLECTION

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
1	A		1	A		1	A	
1	A		1	A		1	A	
,,	,,	A A	,,	,,	A3a aA	,,	,,	A2a aAa
,,	,,	aA A	,,	,,	aA3a aA	,,	,,	aA2a a.Aa
,,	,,	Aa A	,,	,,	A Aa	,,	,,	A3a aAa
,,	,,	aAa A	,,	,,	aA Aa	,,	,,	aA3a aAa
,,	,,	A2a A	,,	,,	Aa Aa	,,	,,	A A2a
,,	,,	aA2a A	,,	,,	aAa Aa	,,	,,	aA A2a
,,	,,	A3a A	,,	,,	A2a Aa	,,	,,	Aa A2a
,,	,,	aA3a A	,,	,,	aA2a Aa	,,	,,	aAa A2a
,,	,,	A aA	,,	,,	A3a Aa	,,	,,	A2a A2a
,,	,,	aA aA	,,	,,	aA3a Aa	,,	,	aA2a A2a
,,	,,	Aa aA	,,	,,	A aAa	,,	,,	A3a A2a
,,	,,	aAa aA	,,	,,	aA aAa	,,	,,	aA3a A2a
,,	,,	A2a aA	,,	,,	Aa aAa	,,	,,	A aA2a
,,	,,	aA2a aA	,,	,,	aAa aAa	,,	,,	aA aA2a

File.		Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
1	A		1	A				
1	A		1	A				
,,	,,	Aa / aA2a	,,	,,	aA2a / aA3a			
,,	,,	aAa / aA2a	,,	,,	A3a / aA3a			
,,	,,	A2a / aA2a	,,	,,	aA3a / aA3a	1	U	
,,	,,	aA2a / aA2a				1	U	
,,	,,	A3a / aA2a	1 / 1	R / A	R / A			
,,	,,	aA3a / aA2a			aR / A			
,,	,,	A / A3a			Ra / A			
,,	,,	aA / A3a						
,,	,,	Aa / A3a			And so on, repre- senting 64 groups, corresponding to those of 1 A			
,,	,,	aAa / A3a						
,,	,,	A2a / A3a						
,,	,,	aA2a / A3a						
,,	,,	A3a / A3a						
,,	,,	aA3a / A3a	1 / 1	U / A				
,,	,,	A / aA3a	1 / 1	A / R				
,,	,,	aA / aA3a	1 / 1	R / R				
,,	,,	Aa / aA3a	1 / 1	U / R				
,,	,,	aAa / aA3a	1 / 1	A / U				
,,	,,	A2a / aA3a	1 / 1	R / U				

Each having 64 groups, corresponding to those of 1 A. See simplified method for filing Arches in 1 1 page 83

Subfile 1 U forms two Subfiles, viz.: 1 U (lettered), in which all the digits are ulnar Loops. For details see next page. 1 U, in which all the digits are ulnar Arches or Radials, and Subfile 1 U, some of the other digits are both index fingers are ulnar Loops, though

PLATE 5—SYNOPSIS 103

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
1	U	(Lettered.)	1	U	I I / I O	32		I I / I I
1	U		1	U	I O / I O	32		I I / I I
,,	,,	aU / U	,,	,,	I O / I O	,,		I M / I I
,,	,,	Ua / U	,,	,,	O I / I O	,,		I O / I I
			,,	,,	O O / I O			
			,,	,,	I I / O I			
			,,	,,	I O / O I			
			,,	,,	O I / O I			
			,,	,,	O O / O I			
			,,	,,	I I / O O			
			,,	,,	I O / O O			
			,,	,,	O I / O O			
			,,	,,	O O / O O			

With groups similar to those of 1 A

Each of these 16 groups can be formed into about 16 sub-groups, according to ridge counts of right little finger.

And so on. As both indexes and both middles are Whorls, the Index may be I, M, or O, also the middle may be I, M, or O. Taken together, there are 9 variations for each hand, or, for the two hands together, 81 groups.

File.	Subfile.	Group.
1	U	I I / I I
1	U	I O / I I
,,	•	O I / I I
,,	••	O O / I I

File.	Subfile.	Group.	File.	Subfile	Group.	File.	Subfile.	Group.
13		I	11		II	32		I
26		II	2		I	24		II
,,		O II	,,		IO I	,,		M II
,,		I IO				,,		O II

And so on. Right index being Loop, but right middle being a Whorl, only 2 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, which, for two hands together, give 8 groups.

And so on. Right index and middle being Loops, there are 4 variations in numerator. Left index being Loop, but left middle a Whorl, there are 2 variations in denominator. So the two hands together give 8 groups.

And so on. Right index a Whorl; but as right middle is Loop, there are only 3 variations in numerator. As both left index and middle are Whorls, there are 9 variations in denominator, or, for two hands together, 27 groups.

File.		Group.	File.		Group.
11		I	29		II
10		I	28		I
,,		O I	,,		IM I

And so on. Both middles being Whorls, there are only 2 variations in numerator for right index, and 2 in denominator for left index, also a Loop, making 4 groups, both hands being taken together.

And so on. Right index and middle being Whorls, there are 9 variations in numerator; but as left middle is Loop, left index only being Whorl, there are 3 variations in denominator, or, for two hands taken together, 27 groups.

The presence of an Arch in the index finger provides for the formation of a subfile or subclass.

The presence of Arches or *radial* loops in digits other than the index fingers are noted in the classification, and filed according to the digits where such Arches occur.

PLATE 5—SYNOPSIS 105

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
17 3		I I M I	31 18		I I M I	13 28		I I O I
		And so on. Both index fingers being Loops, both middle being Loops, there are 3 variations in numerator and 3 in denominator, providing 9 groups.			And so on. Right index a Whorl, but middle a Loop, so 3 variations in numerator. Left index a Loop, left middle a Whorl, so 2 variations in denominator, in all 6 groups.			And so on. Right index being Loop, but right middle a Whorl, there are 2 variations in numerator. Left index being Whorl, but left middle a Loop, there are 3 variations in denominator, making 6 groups.
29 30		II II IM II	15 0		II II IO II			
		And so on. Right index and middle being Loops, being Whorls, there are 9 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, yielding 36 groups.			And so on. Right index and middle Loops, so 4 variations in numerator. Left index and middle Whorls, so 9 variations in denominator, making 36 groups.			

The presence of an Arch in the index finger provides for the formation of a subfile or subclass.

The presence of Arches or *radial* Loops in digits other than the index fingers are noted in the classification, and filed according to the digits where such Arches occur.

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
17 1		I II M II And so on. Right index being Whorl, right middle a Loop, there are 3 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, yielding 12 groups.	15 28		I II O II Right index is Loop, but right middle is Whorl, so 2 variations in numerator. Left index and middle are Whorl, so 9 variations in denominator, making 18 groups.			
32 30		II I IM I And so on. Right index a Whorl, right middle a Whorl, 9 variations in numerator. Left index a Loop, left middle being Whorl, 2 variations in denominator, in all 18 groups.	13 20		II I IO I And so on. Right index and middle being Loops, there are 4 variations in numerator. Left index being Whorl, but left middle a Loop, there are 3 variations in denominator, making 12 groups.			

The presence of an Arch in the index finger provides for the formation of a subfile or subclass.

The presence of Arches in digits other than the index fingers are noted in the classification, and filed according to the digits where such Arches occur.

EXPLANATION OF SYNOPSIS.

The system provides for the formation of 1,024 files or primary classification number.

The data for the subclassification of 16 files are set forth in detail. Any other file may be subclassified in the same way as one of these 16.

The combinations or groups here shown being in excess of the requirements of the largest collection, only some are brought into use.

Groups are disposed amongst themselves in files or subfiles in sequence indicated, viz.: $\frac{A}{A}$ and $\frac{I}{I}$; $\frac{O}{I}$; etc., or $\frac{I\,I}{I\,I}$; $\frac{I\,O}{I\,I}$ etc., or $\frac{I\,I}{I\,I}$; $\frac{I\,M}{I\,I}$; $\frac{I\,O}{I\,I}$, etc.,—a sequence easily remembered.

Capital letters refer to the index finger (fulcrum), small letters to the left of the capital referring to the thumb, those to the right of the capital letter referring to the other digits. Tented Arches come immediately after Arches, and Radials after Tented Arches.

When Arches, Tented Arches, and Radials occur in the subclassification formula, the slip will be found in the subfile indicated by the capital letters where its location is thus determined: Tented Arches come immediately after Arches, and Radials after Tented Arches. If the formula is $\frac{1\ aAt}{1\ aA}$, subfile $\frac{A}{A}$ is taken up, and then the slip will be found arranged below the last slip of $\frac{1\ aAa}{1\ aA}$; slip $\frac{1\ aAa}{1\ aA}$. See simplified method for filing Arches, see plate 1.

Arches
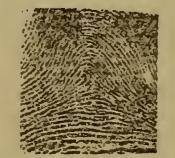
Loops approximating Arches
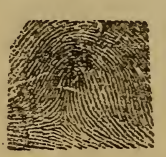
Tented Arches

Loops approximating Tented Arches
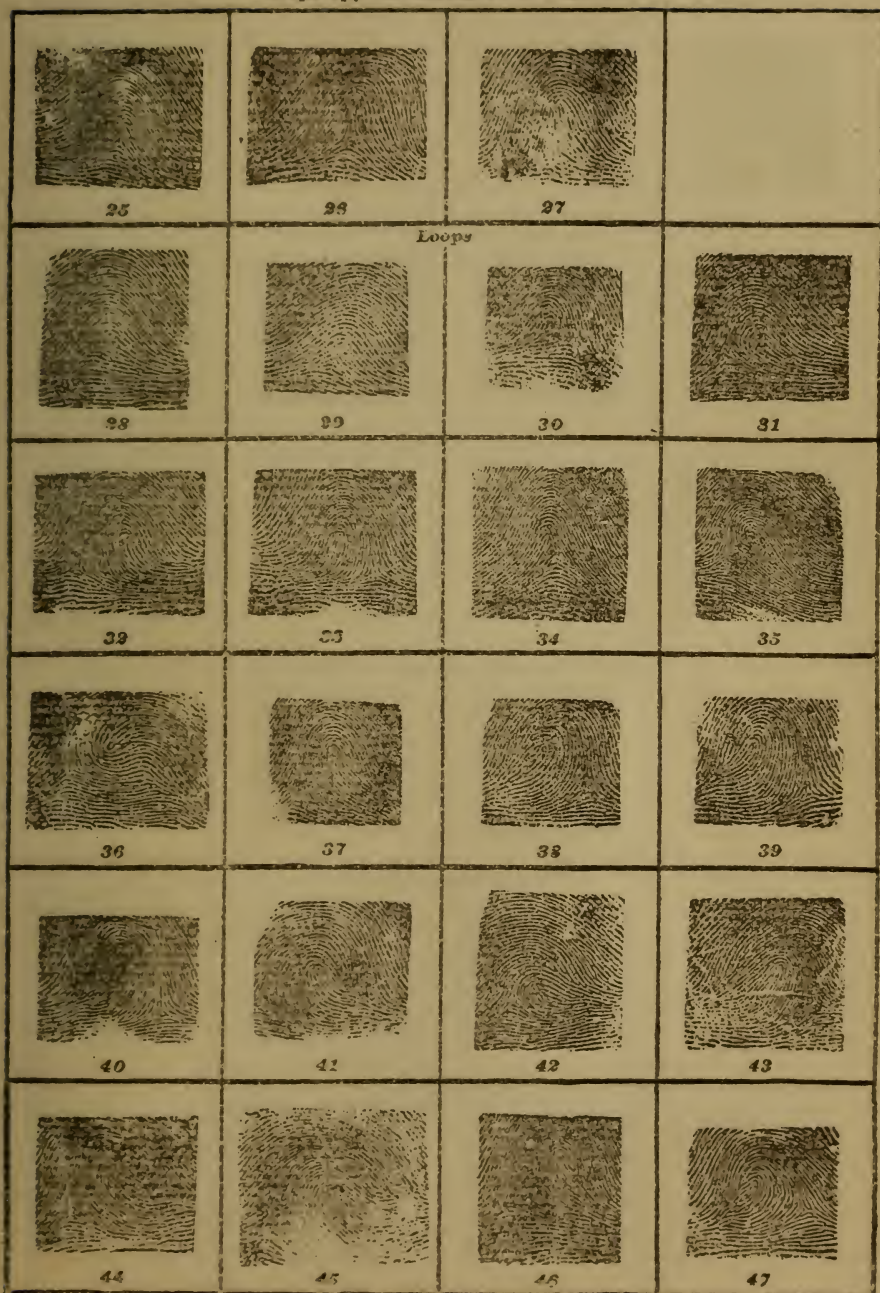
Loops

Loops

48   49

Lateral Pocket Loops

50   51   52   53

54   55   56   57

Loops approximating Lateral Pocket Loops
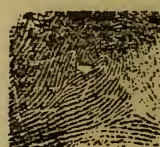
58   59   60   61

62   63   64   65

Twinned Loops

66   67   68   69

Twinned Loops

Central Pocket Loops—Standard I
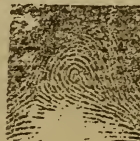
Loops approximating Standard I

Central Pocket Loops—Standard II

Loops approximating Standard II

Central Pocket Loops—Standard III

Central Pocket Loops—Standard III

90

Loops approximating Standard III

91   92   93   94

Central Pocket Loops—Standard IV

95   96   97   98

99   100

Whorls.

101   102   103   104

105   106   107   108

Whorls.

109 110 111 112

113 114 115 116

117 118 119 120

121 122 123 124

Compound Patterns.

125 126 127 128

129 130 131 132
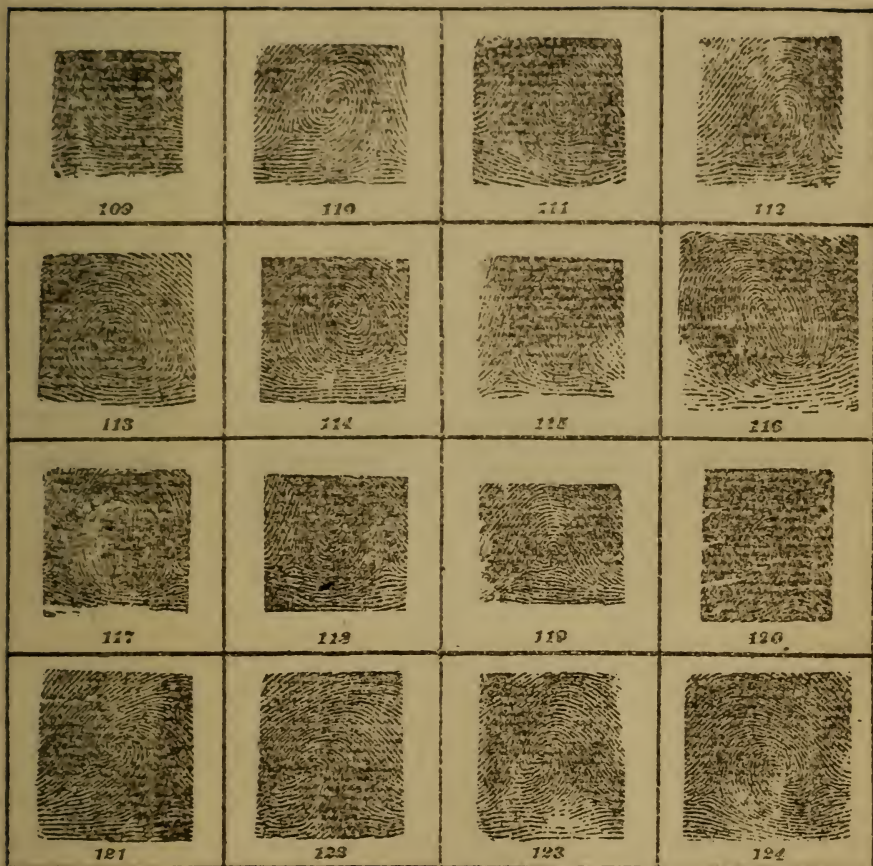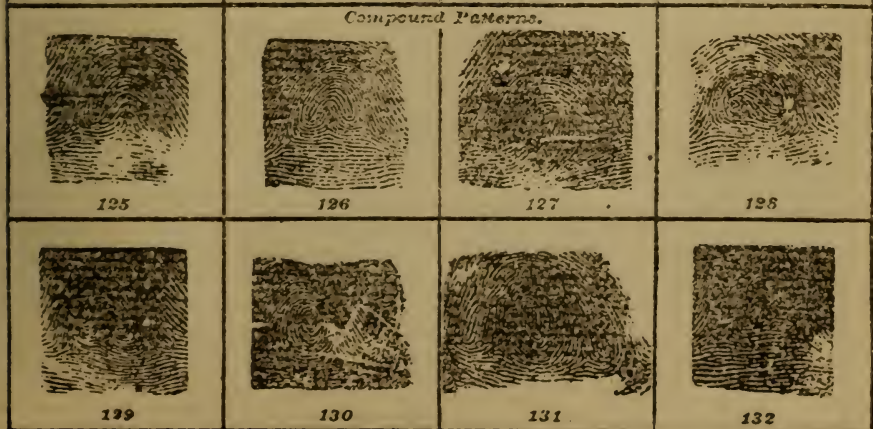
Tracing the Ridges.

Inside

133　　　134　　　135　　　136

Meeting
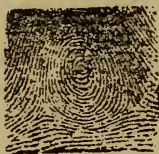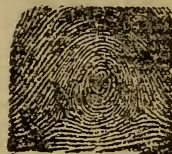
137　　　138　　　139　　　140
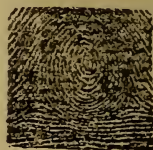
141　　　142　　　143　　　144

Outside
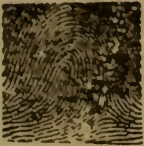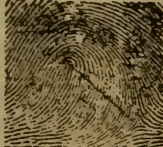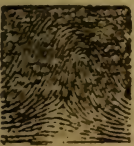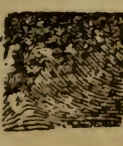
145　　　146　　　147　　　148

Counting the Ridges.

O.T.	O.T.	O.T.	O.T.
I.T.	I.T.	I.T.	I.T.
Counts 13	Counts 15	Counts 14	Counts 6
149	150	151	152
O.T.	O.T.	O.T.	O.T.
I.T.	I.T.	I.T.	I.T.
Counts 15	Counts 26	Counts 11	Counts 19
153	154	155	156
O.T.	O.T.	O.T.	O.T.
I.T.	I.T.	I.T.	I.T.
Counts 15	Counts 10	Counts 15	Counts 11
157	158	159	160
O.T.	O.T.	O.T.	O.T.
I.T.	I.T.	I.T.	I.T.
Counts 7	Counts 15	Counts 10	Counts 10
161	162	163	164

INDEX